ALICAT SCIENTIFIC

Operating Manual

WHISPER

M-Series

MB-Series

MS-Series

Precision Gas Mass Flow Meters

Innovative Flow and Pressure Solutions

CE NIST

RECALIBRATION

Your Alicat instrument is a precision device and Alicat strongly recommends that you send it to us on a yearly basis for recalibration.

A yearly recalibration does a few things:

- **It insures that your unit is functioning according to specification.**
- **Contamination may cause the instrument to measure flow improperly. Recalibration insures the instrument is clean and free from debris.**
- **Recalibration maintains your LIFETIME WARRANTY!**

Sending your unit for recalibration is easy and inexpensive. Recalibrations are usually shipped within five days of receipt, so it's fast too.

Please keep the original box to return your Alicat instrument for recalibration.

For more information regarding recalibration see page 33.

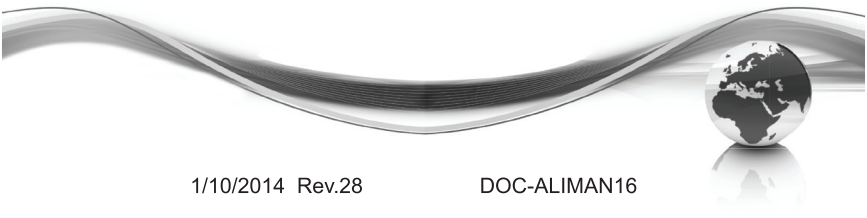
ACCESSORIES

Now that you have your Alicat instrument are you sure you've got everything you need? Alicat accessories can make your job easier.

Many of our customers also order:

- **Power Supplies — A universal wall power supply that makes it easy to power your Alicat unit just about anywhere in the world.**
- **BB9 — Alicat's multi-drop box that allows easy connection of up to nine Alicat instruments to a single USB, RS-232 or RS-485 port.**
- **MD8DB9 — An RS-232 to 8 pin Mini-DIN cable to connect your Alicat instrument to a computer. A variety of other cables are also available.**
- **Flow Vision™ SC — A GUI based Windows®program that allows easy computer access and control for one or multiple Alicat instruments.**
- **Fittings and filters — Keep your instrument properly connected to your process and free from harmful contamination.**

See pages 51-54 for a complete description and list of Alicat accessories.



Thank you for purchasing an Alicat Gas Flow Meter.

Please take the time to read the information contained in this manual. This will help to ensure that you get the best possible service from your instrument. This manual covers the following Alicat Scientific instruments:

M-Series Mass Gas Flow Meters

WHISPER Low Pressure Drop Mass Flow Meters

MS-Series Mass Gas Flow Meters

MS-Series Flow Meters are for use with certain aggressive gases (see page 43).

This includes M-Series devices labeled as approved for CSA Class 1 Div 2 and ATEX Class 1 Zone 2 hazardous environments. See pages 69 and 70 for Special Conditions regarding the use of CSA/ATEX labeled devices.

MB-Series Portable Mass Gas Flow Meters

WHISPER Portable Low Pressure Drop Mass Gas Flow Meters

All MB-Series and Whisper Portable Gas Flow Meters operate in accordance with the instructions found in this manual. Please see page 50 for information regarding battery replacement.

Unless otherwise noted, the instructions in this manual are applicable to all of the above instruments.

Full specifications for each device can be found on pages 34 through 47.

Please contact Alicat at 1-888-290-6060 or info@alicat.com if you have any questions regarding the use or operation of this device.

Many Alicat meters are built for specific applications. Two meters with the same flow range and part number may look and act quite differently depending upon the application the meter was built for. Care should be taken when moving a meter from one application to another.

You can find a number of instructional videos related to the operation of this device by visiting the Alicat web site or scanning the QR code below.
http://www.alicat.com/support/instructional-videos/

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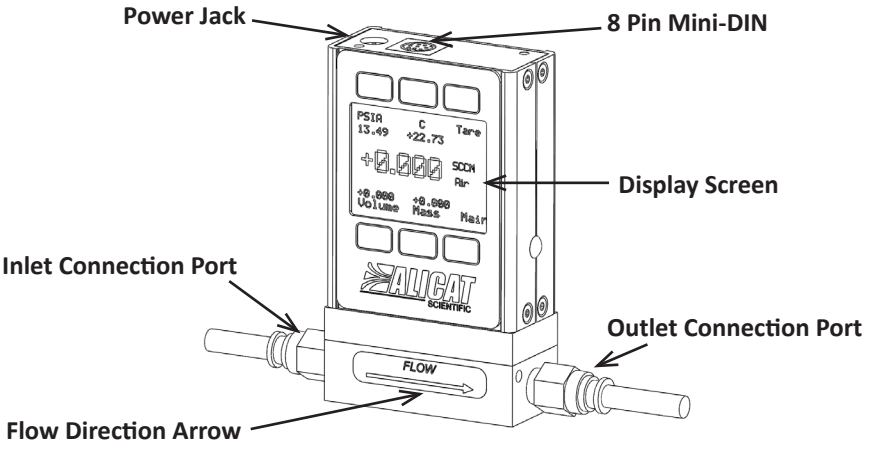
GETTING STARTED



Medium Mass Flow Meter

MOUNTING

M-Series Gas Flow Meters have holes on the bottom for mounting to flat panels. See pages 36-38.

M-Series Meters can usually be mounted in any position.

No straight runs of pipe are required upstream or downstream of the meter.

PLUMBING

Your meter is shipped with plastic plugs fitted in the port openings. To lessen the chance of contaminating the flow stream do not remove these plugs until you are ready to install the device.

Make sure that the gas will flow in the direction indicated by the flow arrow.

Standard M-Series Gas Flow Meters have female inlet and outlet port connections. Welded VCR and other specialty fittings may have male ports.

The inlet and outlet port sizes (process connections) for different flow ranges are shown on pages 38-51.

Meters with M5 (10-32) ports have O-ring face seals and require no sealant or tape. Do not use tape with welded or O-ring fittings.

For non M5 (10-32) ports use thread sealing Teflon® tape to prevent leakage around the port threads.
Do not wrap the first two threads. This will minimize the possibility of getting tape into the flow stream and flow body.

Do not use pipe dopes or sealants on the process connections as these compounds can cause permanent damage to the meter should they get into the flow stream.

We recommend the use of in-line sintered filters to prevent large particulates from entering the measurement head of the instrument. Suggested maximum particulate sizes are as follows:
5 microns for units with FS flow ranges of 0-1 sccm or less.
20 microns for units with FS flow ranges between 0-2 sccm and 0-1 slpm.
50 microns for units with FS flow ranges of 0-1 slpm or more.

Connecting Fittings and Filters
http://www.alicat.com/support/instructional-videos/

PRESSURE

Maximum operating line pressure for M-Series units is 145 psig (1 MPa).

If the line pressure is higher than 145 psig (1 MPa), use a pressure regulator upstream from the flow meter to reduce the pressure to 145 psig (1 MPa) or less.

Maximum operating line pressure for WHISPER units is 50 psig.

Exceeding the maximum specified line pressure may cause permanent damage to the solid-state differential pressure sensor.

STOP

DO NOT SUBJECT AN *M-SERIES* DIFFERENTIAL PRESSURE SENSOR TO UPSTREAM-DOWNSTREAM PRESSURE DIFFERENTIALS EXCEEDING 75 PSID.

DO NOT SUBJECT A *WHISPER* DIFFERENTIAL PRESSURE SENSOR TO UPSTREAM-DOWNSTREAM PRESSURE DIFFERENTIALS EXCEEDING 15 PSID.

While high static pressure will typically not damage the dp sensor, sudden pressure "spikes" can result in complete failure of the sensor.

A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve either upstream or downstream of the meter. If you suspect that your pressure sensor is damaged please discontinue use of the meter and contact Alicat.

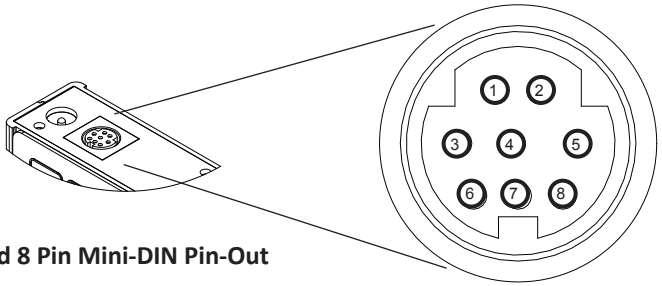
POWER AND SIGNAL CONNECTIONS

Power can be supplied to your meter through either the power jack (power jack not available on CSA/ATEX approved devices) or the 8 pin Mini-DIN connector.

An AC to DC adapter which converts line AC power to DC voltage and current as specified below is required to use the power jack.

Meters require a 7-30 Vdc power supply with a 2.1 mm female positive center plug capable of supplying at least 100mA.

Note: 4-20mA analog output requires at least 15 Vdc.



Standard 8 Pin Mini-DIN Pin-Out

Pin	Function	Mini-DIN cable color
1	Not Connected (or optional 4-20mA Primary Output Signal)	Black
2	Static 5.12 Vdc [or optional Secondary Analog Output (4-20mA, 5Vdc, 10Vdc) or Basic Alarm]	Brown
3	Serial RS-232RX / RS-485(–) Input Signal (receive)	Red
4	Analog Input Signal	Orange
5	Serial RS-232TX / RS-485(+) Output Signal (send)	Yellow
6	0-5 Vdc (or optional 0-10 Vdc) Output Signal	Green
7	Power In (as described above)	Blue
8	Ground (common for power, digital communications, analog signals and alarms)	Purple
Note: The above pin-out is applicable to all the flow meters and controllers with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.		

CAUTION! ***DO NOT CONNECT POWER TO PINS 1 THROUGH 6 AS PERMANENT DAMAGE CAN OCCUR!***

It is common to mistake Pin 2 (labeled 5.12 Vdc Output) as the standard 0-5 Vdc analog output signal. In fact Pin 2 is normally a constant 5.12 Vdc that reflects the system bus voltage and can be used as a source for the set-point signal.

For 6 Pin Locking Industrial Connector, DB9, and DB15 Pin-outs, see pages 58 to 68. For PROFIBUS Pin-out, see page 48

INPUT SIGNALS

Analog Input Signal

Apply analog input to Pin 4 as shown on page 8.

For 6 Pin Locking Connector, DB9 and DB15 Pin-outs, see pages 58 to 68.
For PROFIBUS Pin-out, see page 48.

Standard 0-5 Vdc is the standard analog input signal. Apply the 0-5 Vdc input signal to pin 4, with common ground on pin 8.

Optional 0-10 Vdc: If specified at time of order, a 0-10 Vdc input signal can be applied to pin 4, with common ground on pin 8.

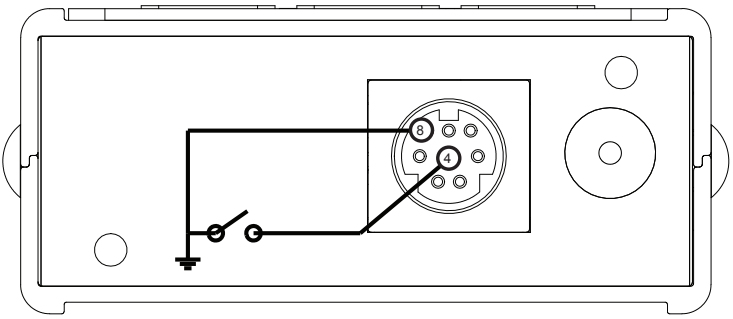
Optional 4-20 mA: If specified at time of order, a 4-20 mA input signal can be applied to pin 4, with common ground on pin 8.

NOTE: This is a current sinking device. The receiving circuit is essentially a 250 ohm resistor to ground.

NOTE: 4-20 mA output requires at least 15 Vdc power input.

CAUTION! ***DO NOT CONNECT THIS DEVICE TO "LOOP POWERED" SYSTEMS, AS THIS WILL DESTROY PORTIONS OF THE CIRCUITRY AND VOID THE WARRANTY. IF YOU MUST INTERFACE WITH EXISTING LOOP POWERED SYSTEMS, ALWAYS USE A SIGNAL ISOLATOR AND A SEPARATE POWER SUPPLY.***

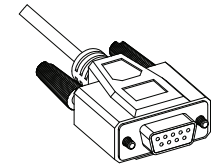
Electrical Connections and Basic Wiring
http://www.alicat.com/support/instructional-videos/

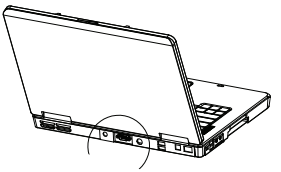


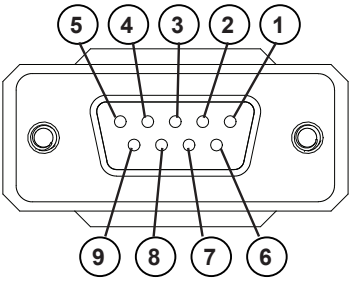
A remote tare can be achieved by momentarily grounding pin 4 to tare as shown above.

RS-232 / RS-485 Digital Input Signal

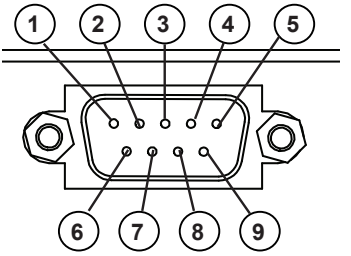
To use the RS-232 or RS-485 input signal, connect the RS-232 / RS-485 Output Signal (Pin 5), the RS-232 / RS-485 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown below. (See page 23 for details on accessing RS-232 / RS-485 input.)



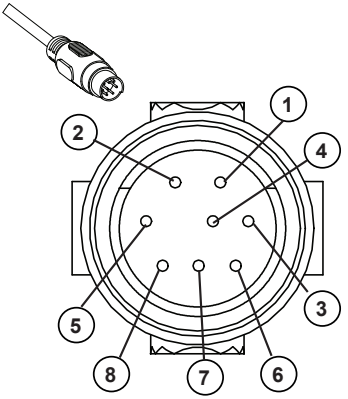




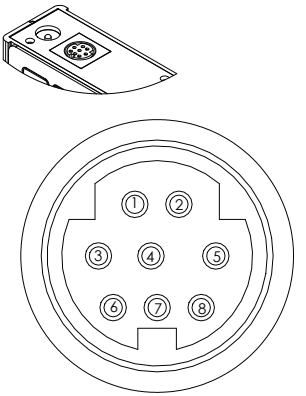
Serial Cable End



PC Serial Port



8 Pin MiniDIN Cable End



8 Pin MiniDIN Connector

9 Pin Serial Connection		8 Pin MiniDIN Connection	
Pin	Function	Function	Pin
5	Ground	Ground	8
3	Transmit	Receive	3
2	Receive	Transmit	5

DB9 to Mini-DIN Connection for RS-232 / RS-485 Signals

Communication Set Up
http://www.alicat.com/support/instructional-videos/

OUTPUT SIGNALS

RS-232 / RS-485 Digital Output Signal

To use the RS-232 or RS-485 output signal, it is necessary to connect the RS-232 / RS-485 Output Signal (Pin 5), the RS-232 / RS-485 Input Signal (Pin 3), and Ground (Pin 8) to your computer serial port as shown on page 8. (See page 22 for details on accessing RS-232 / RS-485 output.)

Standard Voltage (0-5 Vdc) Output Signal

M-Series flow meters equipped with a 0-5 Vdc (optional 0-10 Vdc) will have this output signal available on Pin 6. This output is generally available in addition to other optionally ordered outputs. This voltage is usually in the range of 0.010 Vdc for zero flow and 5.0 Vdc for full-scale flow. The output voltage is linear over the entire range. Ground for this signal is common on Pin 8.

Optional 0-10 Vdc Output Signal

If your meter was ordered with a 0-10 Vdc output signal, it will be available on Pin 6. (See the Calibration Data Sheet that shipped with your meter to determine which output signals were ordered.) This voltage is usually in the range of 0.010 Vdc for zero flow and 10.0 Vdc for full-scale flow. The output voltage is linear over the entire range. Ground for this signal is common on Pin 8.

Optional Current (4-20 mA) Output Signal

If your meter was ordered with a 4-20 mA current output signal, it will be available on Pin 1. (See the Calibration Data Sheet that shipped with your meter to determine which output signals were ordered.) The current signal is 4 mA at 0 flow and 20 mA at the meter's full scale flow. The output current is linear over the entire range. Ground for this signal is common on Pin 8. (Current output units require 15-30Vdc power.)

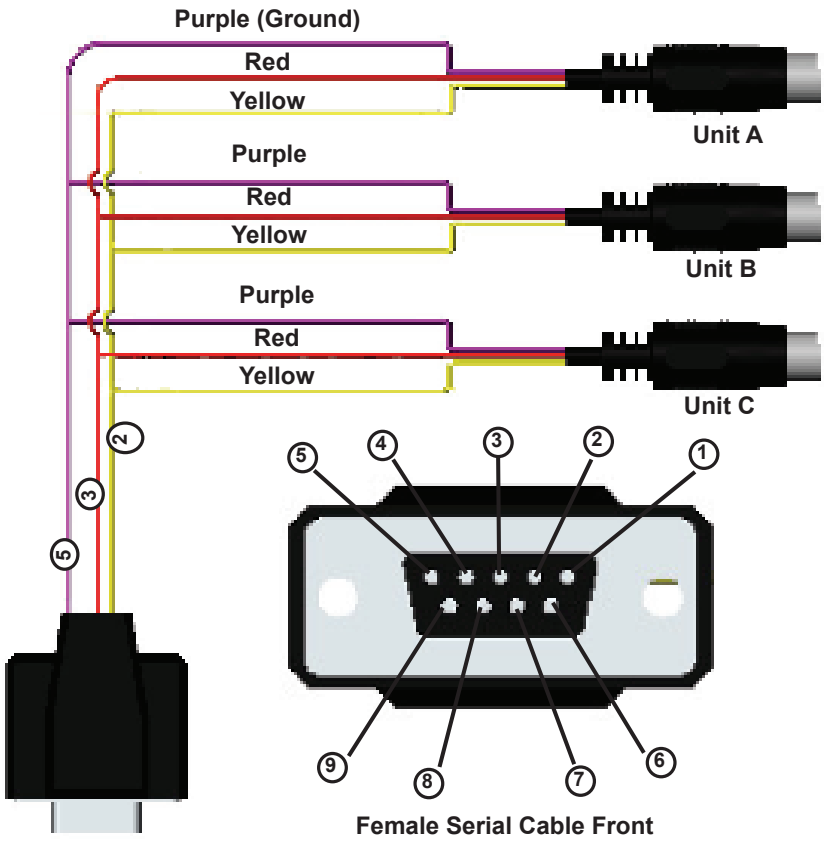
Optional 2nd Analog Output Signal

You may specify an optional 2nd analog output on Pin 2 at time of order. (See the Calibration Data Sheet that shipped with your meter to determine which output signals were ordered.) This output may be a 0-5 Vdc, 0-10 Vdc, or 4-20 mA analog signal that can represent any measured parameter. With this optional output, a meter could output the mass flow rate (0-5 Vdc on pin 6) and the absolute pressure (0-5 Vdc on pin 2).

If your device is CSA/ATEX approved or equipped with the optional six pin industrial connector, please contact Alicat.

CAUTION! ***DO NOT CONNECT THIS DEVICE TO "LOOP POWERED" SYSTEMS, AS THIS WILL DESTROY PORTIONS OF THE CIRCUITRY AND VOID THE WARRANTY. IF YOU MUST INTERFACE WITH EXISTING LOOP POWERED SYSTEMS, ALWAYS USE A SIGNAL ISOLATOR AND A SEPARATE POWER SUPPLY.***

CAUTION! ***DO NOT CONNECT THIS DEVICE TO "LOOP POWERED" SYSTEMS, AS THIS WILL DESTROY PORTIONS OF THE CIRCUITRY AND VOID THE WARRANTY. IF YOU MUST INTERFACE WITH EXISTING LOOP POWERED SYSTEMS, ALWAYS USE A SIGNAL ISOLATOR AND A SEPARATE POWER SUPPLY.***



Typical Multiple Device (Addressable) Wiring Configuration

The easiest way to connect multiple devices is with a Multi-Drop Box (see page 52).

Information for Alicat TFT (Color Display) Instruments

Alicat TFT (color display) instruments have a high contrast back-lit LCD display. TFT instruments operate in accordance with Alicat standard operating instructions for our monochrome menus and displays with the following differences.

Multi-Color Display Color Codes:

GREEN: Green labels identify the parameters and/or adjustments associated with the button directly above or below the label.

WHITE: The color of each parameter is displayed in white while operating under normal conditions.

RED: The color of a parameter is displayed in red when operating conditions for that parameter exceed 128% of the device's specifications.

YELLOW: Yellow is the equivalent of the selection arrow on the monochrome display.

LCD Contrast:
LCD contrast is ranged from 1 to 11 on color displays with 11 being the greatest contrast.

Display On/Off:
Pushing the button under the Alicat name will turn the device display on or off. This feature is not available on monochrome displays.

Technical Data for TFT (Color Display) Meters, Gauges and Controllers

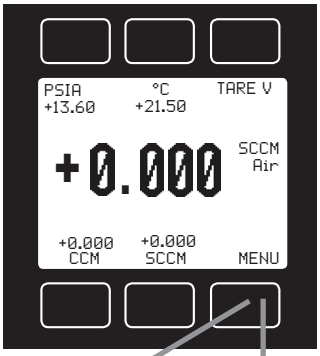
The following specifications are applicable to Alicat **TFT** (color display) meters, gauges and controllers only. All other operating specifications are shown in the Technical Data page for standard Alicat instruments. All standard device features and functions are available and operate in accordance with the Alicat operating manual provided with the device.

Specification	Meter or Gauge	Small Valve Controller	Large Valve Controller
Supply Voltage	7 to 30 Vdc	12 to 30 Vdc	24 to 30 Vdc
Supply Current	80 mA @ 12Vdc 70 mA @ 24Vdc	290 mA @ 12Vdc 200 mA @ 24Vdc	780 mA @ 24Vdc

DISPLAYS AND MENUS

The device screen defaults to **Main** display as soon as power is applied to the meter.

Main

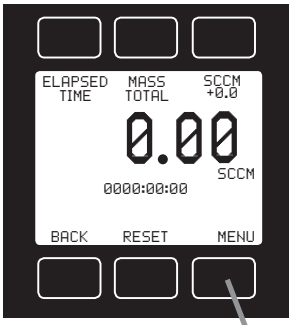


The **Main** display shows pressure, temperature, volumetric flow and mass flow.

Pressing the button adjacent to a parameter will make that parameter the primary display unit.

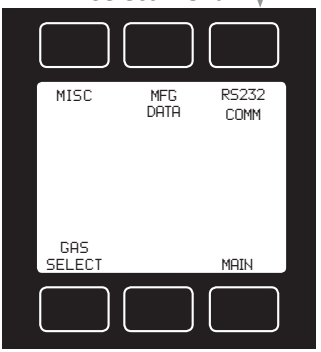
By hitting the **MENU** button at the bottom right of the screen you will enter the **Select Menu** display.

Totalizer (option only)



If your meter was ordered with the **Totalizer** option (page 49), pushing the **MENU** button once will bring up the **Totalizing Mode** display. Pushing **MENU** a second time will bring up the **Select Menu** display.

Select Menu

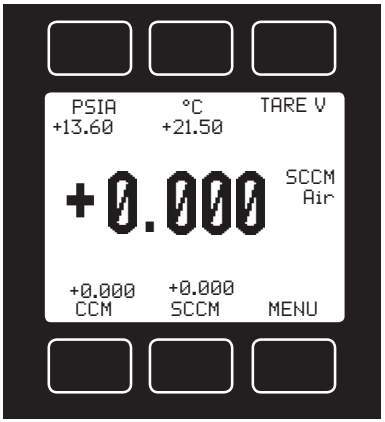


Select Menu

From **Select Menu** you can change the selected gas, interact with your RS-232 / RS-485 settings or read manufacturer's data.

Push **MAIN** to return to the Main display.

MAIN



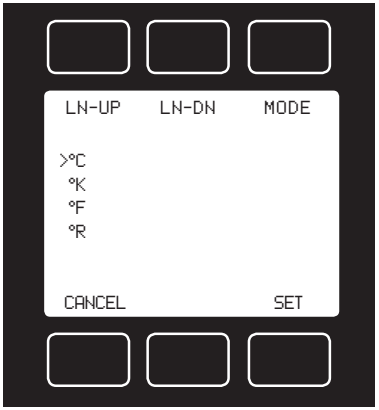
This mode defaults on power up, with mass flow as the primary displayed parameter.

The following parameters are displayed in the Main mode.

Gas Absolute Pressure: This sensor references hard vacuum and reads incoming pressure both above and below local atmospheric pressure. This parameter is moved to the primary display by pushing the button above **PSIA**.

The engineering unit associated with absolute pressure is pounds per square inch absolute (psia). This can be converted to gage pressure (psig) by subtracting local atmospheric pressure from the absolute pressure reading:

PSIG = PSIA – (Local Atmospheric Pressure)



Gas Temperature: M-Series flow meters measure the incoming temperature of the gas flow. The temperature is displayed in degrees Celsius (°C). This parameter is moved to the primary display by pushing the button above **°C**.

Pushing the button again allows you to select °C (Celsius), °K (Kelvin), °F (Fahrenheit) or °R (Rankine) for the temperature scale.

To select a temperature scale, use the LN-UP and LN-DN buttons to position the arrow in front of the desired scale.

Press SET to record your selection and return to the MAIN display. The selected temperature scale will be displayed on the screen.

Tare: Pushing the **TARE V** button tares the flow meter and provides it with a reference point for zero flow. This is an important step in obtaining accurate measurements. It is best to zero the flow meter each time it is powered up. If the flow reading varies significantly from zero after an initial tare, give the unit a minute or so to warm up and re-zero it.

If possible, zero the unit near the expected operating pressure by positively blocking the flow downstream of the flow meter prior to pushing the TARE button.

Zeroing the unit while there is any flow will directly affect the accuracy by providing a false zero point. If in doubt about whether a zero flow condition exists, remove the unit from the line and positively block both ports before pressing the TARE button. If the unit reads a significant negative value

when removed from the line and blocked, it was given a false zero. It is better to zero the unit at atmospheric pressure and a confirmed no flow condition than to give it a false zero under line pressure.

Volumetric Flow Rate: This parameter is located in the lower left of the display. It is moved to the primary display by pushing the button below **CCM** in this example. Your display may show a different unit of measure.

Mass Flow Rate: The mass flow rate is the volumetric flow rate corrected to a standard temperature and pressure (typically 14.696 psia and 25 °C).

This parameter is located in the lower middle of the display. It can be moved to the primary display by pushing the button below **SCCM** in this example. Your display may show a different unit of measure preceded by the letter **S**.

To get an accurate volumetric or mass flow rate, the gas being measured must be selected. See Gas Select, page 18.

MENU: Pressing **MENU** switches the screen to the **Select Menu** display.

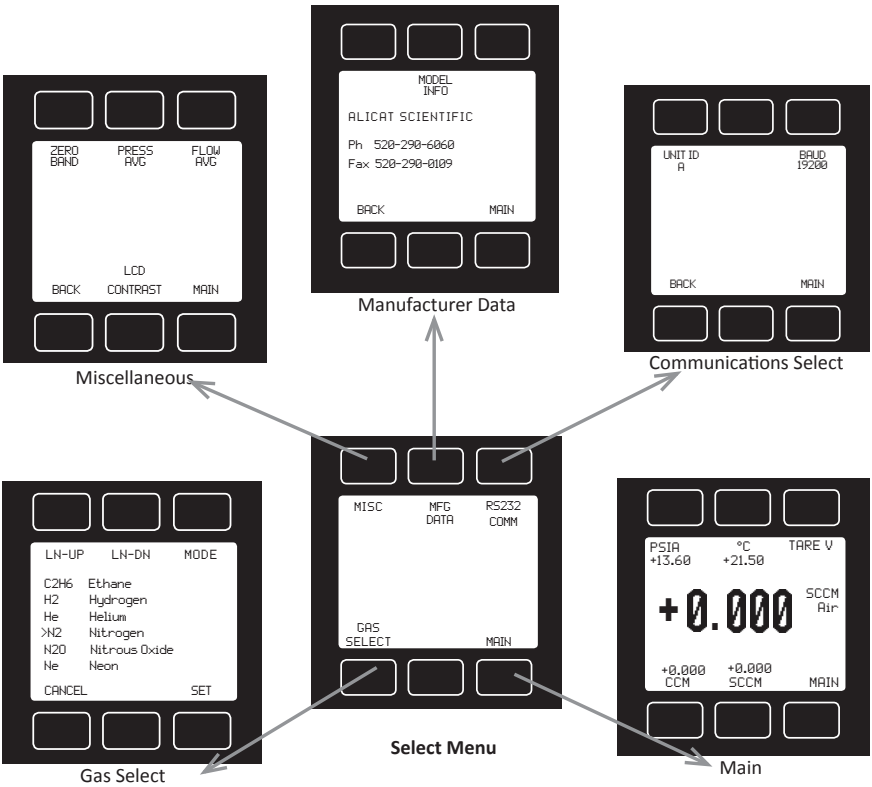
Flashing Error Message: An error message (**MOV** = mass overrange, **VOV** = volumetric overrange, **POV** = pressure overrange, **TOV** = temperature overrange) flashes when a measured parameter exceeds the range of the sensor. When any item flashes, neither the flashing parameter nor the mass flow measurement is accurate. Reducing the value of the flashing parameter to within specified limits will return the unit to normal operation and accuracy.

If the unit does return to normal operation contact Alicat.

SELECT MENU

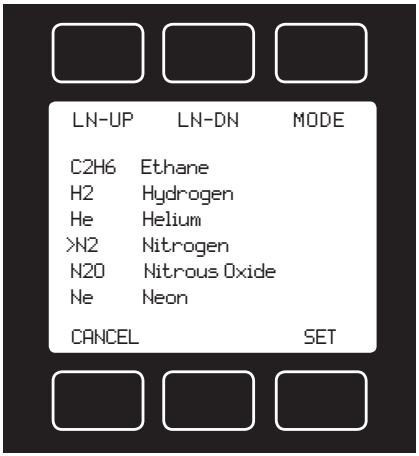
From Select Menu you can change the selected gas, interact with your RS-232 / RS-485 settings or read manufacturer's data.

Press the button next to the desired operation to bring that function to the screen.



An explanation for each screen can be found on the following pages.

GAS SELECT



Gas Select is accessed by pressing the button below **GAS SELECT** on the Select Menu display.

To select a gas, use the LN-UP and LN-DN buttons to position the arrow in front of the desired gas.

Press MODE and then PG-UP or PG-DN to view a new page in the gas list.

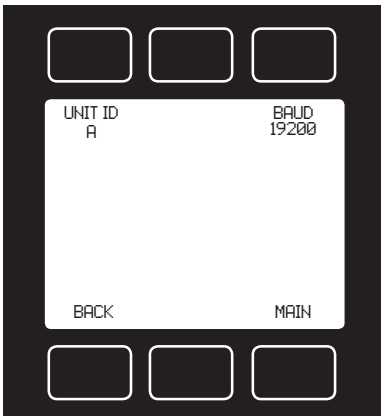
Press SET to record your selection and return to the MAIN display. The selected gas will be displayed on the screen.

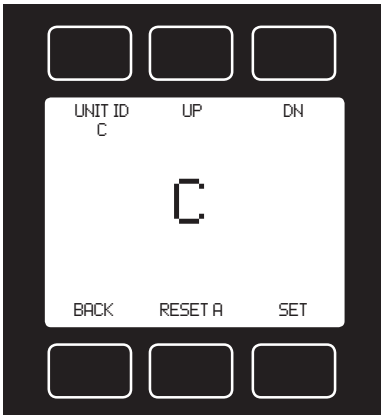
Note: Gas Select may not be available on units ordered with a custom gas or blend.

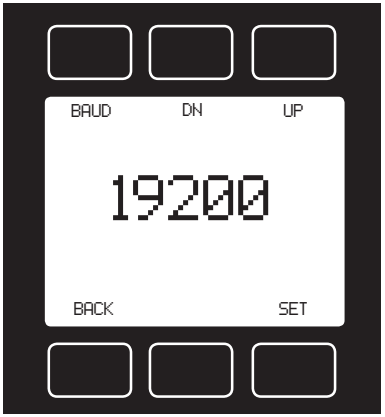
See page 43 for MS-Series Gas Select List.

Alicat Standard Gas Select List	
Air	Air
Ar	Argon
CH4	Methane
CO	Carbon Monoxide
CO2	Carbon Dioxide
C2H6	Ethane
H2	Hydrogen
He	Helium
N2	Nitrogen
N2O	Nitrous Oxide
Ne	Neon
O2	Oxygen
C3H8	Propane
n-C4H10	normal-Butane
C2H2	Acetylene
C2H4	Ethylene
i-C2H10	iso-Butane
Kr	Krypton
Xe	Xenon
SF6	Sulfur Hexafluoride
C-25	75% Argon / 25% CO2
C-10	90% Argon / 10% CO2
C-8	92% Argon / 8% CO2
C-2	98% Argon / 2% CO2
C-75	75% CO2 / 25% Argon
A-75	75% Argon / 25% Helium
A-25	75% Helium / 25% Argon
A1025	90% Helium / 7.5% Argon / 2.5% CO2 (Praxair - Helistar® A1025)
Star29	90% Argon / 8% CO2 / 2% Oxygen (Praxair - Stargon® CS)
P-5	95% Argon / 5% Methane

COMMUNICATION SELECT







Access **Communication Select** by pressing the button above **RS232 COMM** or **RS485 COMM** on the **Select Menu** display.

Unit ID – Valid unit identifiers are the letters A-Z and @. The identifier allows you to assign a unique address to each device so that multiple units can be connected to a single RS-232 or RS-485 computer port.

Press **UNIT ID**. Use the UP and DOWN buttons to change the Unit ID. Press SET to record the ID. Press Reset to return to the previously recorded Unit ID.

Any Unit ID change will take effect when Communication Select is exited.

If the symbol @ is selected as the Unit ID, the device will enter streaming mode when Communication Select is exited.

See RS-232 Communications (page 23) for information about the streaming mode.

Baud – Both this instrument and your computer must send/receive data at the same baud rate. The default baud rate for this device is 19200 baud.

Press the Select button until the arrow is in front of **Baud**. Use the UP and DOWN buttons to select the baud rate that matches your computer. The choices are 38400, 19200, 9600, or 2400 baud.

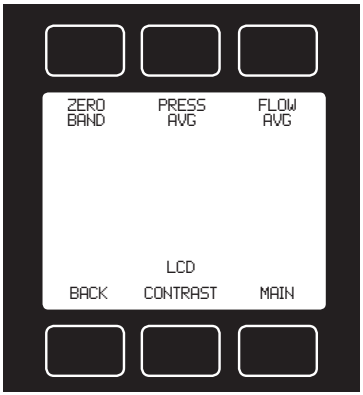
Any baud rate change will not take effect until power to the unit is cycled.

MISCELLANEOUS

Miscellaneous is accessed by pressing the **MISC** button on the Select Menu display.

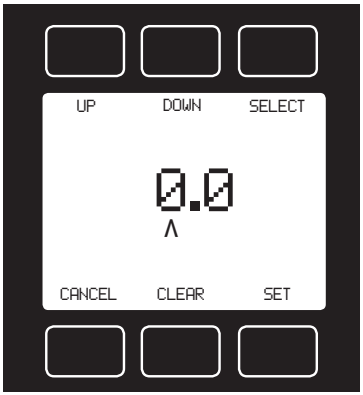
NOTE: All Miscellaneous changes are recorded when you exit Miscellaneous.

ZERO BAND refers to Display Zero Deadband. Zero deadband is a value below which the display jumps to zero. This deadband is often desired to prevent electrical noise from showing up on the display as minor flows or pressures that do not exist. Display Zero Deadband does not affect the analog or digital signal outputs.



ZERO BAND can be adjusted between 0 and 3.2% of the sensor's Full Scale (FS).

Press **ZERO BAND.** Then use SELECT to choose the decimal with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

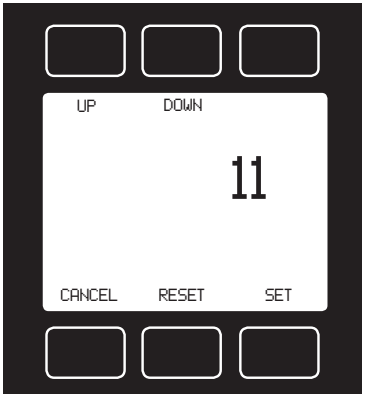


Pressure Averaging and Flow Averaging may be useful to make it easier to read and interpret rapidly fluctuating pressures and flows. Pressure and flow averaging can be adjusted between 1 (no averaging) and 256 (maximum averaging). These are geometric running averages where the number between 1 and 256 can be considered roughly equivalent to the response time constant in milliseconds. This can be effective at "smoothing" high frequency process oscillations such as those caused by diaphragm pumps.

Press **PRESS AVG.** Then use SELECT to choose the decimal with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Press **FLOW AVG**. Then use SELECT to choose the decimal with the arrow and the UP and DOWN buttons to change the value. Press SET to record your value. Press CLEAR to return to zero.

Setting a higher number will equal a smoother display.

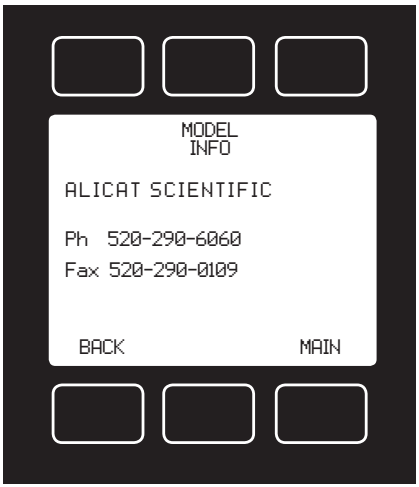


LCD CONTRAST: The display contrast can be adjusted between 0 and 30, with zero being the lightest and 30 being the darkest.

Use the UP and DOWN buttons to adjust the contrast. Press SET when you are satisfied.

Press CANCEL to return to the MISC display.

MANUFACTURER DATA



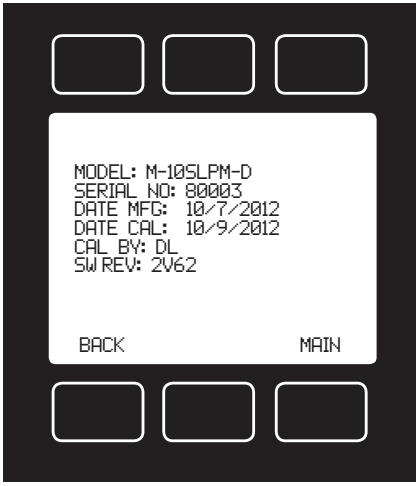
Manufacturer Data is accessed by pressing the **MFG DATA** button on the Select Menu display.

The initial display shows the name and telephone number of the manufacturer.

Press **MODEL INFO** to show important information about your flow meter including the model number, serial number, and date of manufacture.

Press BACK to return to the MFG DATA display.

Push MAIN to return to the Main display.



Configuring HyperTerminal®:

1. Open your HyperTerminal® RS-232 / RS-485 terminal program (installed under the "Accessories" menu on all Microsoft Windows® operating systems).
2. Select "Properties" from the file menu.
3. Click on the "Configure" button under the "Connect To" tab. Be sure the program is set for: 19,200 baud (or matches the baud rate selected in the RS-232 / RS-485 communications menu on the meter) and an 8-N-1-None (8 Data Bits, No Parity, 1 Stop Bit, and no Flow Control) protocol.
4. Under the "Settings" tab, make sure the Terminal Emulation is set to ANSI or Auto Detect.
5. Click on the "ASCII Setup" button and be sure the "Send Line Ends with Line Feeds" box is not checked and the "Echo Typed Characters Locally" box and the "Append Line Feeds to Incoming Lines" boxes are checked. Those settings not mentioned here are normally okay in the default position.
6. Save the settings, close HyperTerminal® and reopen it.

In Polling Mode, the screen should be blank except the blinking cursor. In order to get the data streaming to the screen, hit the "Enter" key several times to clear any extraneous information. Type "*@=@" followed by "Enter" (or using the RS-232 / RS-485 communication select menu, select @ as identifier and exit the screen). If data still does not appear, check all the connections and com port assignments.

Tareing via RS-232 / RS-485:

Tare –Tareing (or zeroing) the flow meter provides it with a reference point for zero flow. This is a simple but important step in obtaining accurate measurements. It is good practice to "zero" the flow meter each time it is powered up. A unit may be Tared by following the instructions on page 10 or it may be Tared via RS-232 / RS-485 input.

To send a Tare command via RS-232 / RS-485, enter the following strings:

In Polling Mode: Address$$V<Enter> (e.g. B$$V<Enter>)

Changing From Streaming to Polling Mode:

When the meter is in the Streaming Mode (*RS-485 units do not have a streaming mode*), the screen is updated approximately 10-60 times per second (depending on the amount of data on each line) so that the user sees the data essentially in real time. It is sometimes desirable, and necessary when using more than one unit on a single RS-232 line, to be able to poll the unit.

Communication Set Up
http://www.alicat.com/support/instructional-videos/

In Polling Mode the unit measures the flow normally, but only sends a line of data when it is “polled”. Each unit can be given its own unique identifier or address. Unless otherwise specified each unit is shipped with a default address of capital A. Other valid addresses are B thru Z.

Once you have established communication with the unit and have a stream of information filling your screen:

1. Type *@=A followed by “Enter” (or using the RS-232 / RS-485 communication select menu, select A as identifier and exit the screen) to stop the streaming mode of information. Note that the flow of information will not stop while you are typing and you will not be able to read what you have typed. Also, the unit does not accept a backspace or delete in the line so it must be typed correctly. If in doubt, simply hit enter and start again. If the unit does not get exactly what it is expecting, it will ignore it. If the line has been typed correctly, the data will stop.
2. You may now poll the unit by typing A followed by “Enter”. This does an instantaneous poll of unit A and returns the values once. You may type A “Enter” as many times as you like. Alternately you could resume streaming mode by typing *@=@ followed by “Enter”. Repeat step 1 to remove the unit from the streaming mode.
3. To assign the unit a new address, type *@=New Address, e.g. *@=B. Care should be taken not to assign an address to a unit if more than one unit is on the RS-232 / RS-485 line as all of the addresses will be reassigned. Instead, each should be individually attached to the RS-232 / RS-485 line, given an address, and taken off. After each unit has been given a unique address, they can all be put back on the same line and polled individually.

Gas Select – The selected gas can be changed via RS-232 / RS-485 input. To change the selected gas, enter the following commands:

In Polling Mode: Address$$#<Enter> (e.g. B$$#<Enter>)

Where # is the number of the gas selected from the table below. Note that this also corresponds to the gas select menu on the flow meter screen:

#	GAS	
0	Air	Air
1	Argon	Ar
2	Methane	CH4
3	Carbon Monoxide	CO
4	Carbon Dioxide	CO2
5	Ethane	C2H6
6	Hydrogen	H2
7	Helium	He
8	Nitrogen	N2
9	Nitrous Oxide	N2O
10	Neon	Ne
11	Oxygen	O2
12	Propane	C3H8
13	normal-Butane	n-C4H10
14	Acetylene	C2H2
15	Ethylene	C2H4
16	iso-Butane	i-C2H10
17	Krypton	Kr
18	Xenon	Xe
19	Sulfur Hexafluoride	SF6
20	75% Argon / 25% CO2	C-25
21	90% Argon / 10% CO2	C-10
22	92% Argon / 8% CO2	C-8
23	98% Argon / 2% CO2	C-2
24	75% CO2 / 25% Argon	C-75
25	75% Argon / 25% Helium	A-75
26	75% Helium / 25% Argon	A-25
27	90% Helium / 7.5% Argon / 2.5% CO2 (Praxair - Helistar® A1025)	A1025
28	90% Argon / 8% CO2 / 2% Oxygen (Praxair - Stargon® CS)	Star29
29	95% Argon / 5% Methane	P-5

For example, to select Propane, enter: $$12<Enter>

Collecting Data:

The RS-232 / RS-485 output updates to the screen many times per second. Very short-term events can be captured simply by disconnecting (there are two telephone symbol icons at the top of the HyperTerminal® screen for disconnecting and connecting) immediately after the event in question. The scroll bar can be driven up to the event and all of the data associated with the event can be selected, copied, and pasted into Microsoft® Excel® or other spreadsheet program as described below.

For longer term data, it is useful to capture the data in a text file. With the desired data streaming to the screen, select “Capture Text” from the Transfer Menu. Type in the path and file name you wish to use. Push the start button. When the data collection period is complete, simply select “Capture Text” from the Transfer Menu and select “Stop” from the sub-menu that appears.

Data that is selected and copied, either directly from HyperTerminal® or from a text file can be pasted directly into Excel®. When the data is pasted it will all be in the selected column. Select “Text to Columns...” under the Data menu in Excel® and a Text to Columns Wizard (dialog box) will appear. Make sure that “Fixed Width” is selected under Original Data Type in the first dialog box and click “Next”. In the second dialog box, set the column widths as desired, but the default is usually acceptable. Click on “Next” again. In the third dialog box, make sure the column data format is set to “General”, and click “Finish”. This separates the data into columns for manipulation and removes symbols such as the plus signs from the numbers. Once the data is in this format, it can be graphed or manipulated as desired.

For extended term data capture see: “Sending a Simple Script to HyperTerminal®” on page 27.

Data Format:

The data stream on the screen represents the flow parameters of the main mode in the units shown on the display.

For mass flow meters, there are five columns of data representing pressure, temperature, volumetric flow, mass flow and the selected gas. The first column is absolute pressure (normally in psia), the second column is temperature (normally in °C), the third column is volumetric flow rate (in the units specified at time of order and shown on the display), and the fourth column is mass flow (also in the units specified at time of order and shown on the display). For instance, if the meter was ordered in units of scfm, the display on the meter would read 2.004 scfm and the last two columns of the output below would represent volumetric flow and mass flow in cfm and scfm respectively.

```
+014.70  +025.00  +02.004  +02.004  Air
+014.70  +025.00  +02.004  +02.004  Air
+014.70  +025.00  +02.004  +02.004  Air
+014.70  +025.00  +02.004  +02.004  Air
+014.70  +025.00  +02.004  +02.004  Air
+014.70  +025.00  +02.004  +02.004  Air
```

M-Series Mass Flow Meter Data Format

Note: On units with the totalizer function the fifth column will be the totalizer value, with gas select moving to a sixth column.

Sending a Simple Script File to HyperTerminal®

It is sometimes desirable to capture data for an extended period of time. Standard streaming mode information is useful for short term events, however, when capturing data for an extended period of time, the amount of data and thus the file size can become too large very quickly. Without any special programming skills, you can use HyperTerminal® and a text editing program such as Microsoft® Word® to capture text at defined intervals.

1. Open your text editing program, MS Word for example.

2. Set the cap lock on so that you are typing in capital letters.

3. Beginning at the top of the page, type A<Enter> repeatedly. If you're using MS Word, you can tell how many lines you have by the line count at the bottom of the screen. The number of lines will correspond to the total number of times the flow device will be polled, and thus the total number of lines of data it will produce.

For example:
A
A
A
A
A
A

will get a total of six lines of data from the flow meter, but you can enter as many as you like.

The time between each line will be set in HyperTerminal.

4. When you have as many lines as you wish, go to the File menu and select save. In the save dialog box, enter a path and file name as desired and in the "Save as Type" box, select the plain text (.txt) option. It is important that it be saved as a generic text file for HyperTerminal to work with it.

5. Click Save.

6. A file conversion box will appear. In the "End Lines With" drop down box, select CR Only. Everything else can be left as default.

7. Click O.K.

8. You have now created a "script" file to send to HyperTerminal. Close the file and exit the text editing program.

9. Open HyperTerminal and establish communication with your flow device as outlined in the manual.

10. Set the flow device to Polling Mode as described in the manual. Each time you type A<Enter>, the meter should return one line of data to the screen.

11. Go to the File menu in HyperTerminal and select "Properties".

12. Select the "Settings" tab.

13. Click on the "ASCII Setup" button.

14. The “Line Delay” box is defaulted to 0 milliseconds. This is where you will tell the program how often to read a line from the script file you’ve created. 1000 milliseconds is one second, so if you want a line of data every 30 seconds, you would enter 30000 into the box. If you want a line every 5 minutes, you would enter 300000 into the box.

15. When you have entered the value you want, click on OK and OK in the Properties dialog box.

16. Go the Transfer menu and select “Send **Text** File…” (NOT Send File…).

17. Browse and select the text “script” file you created.

18. Click Open.

19. The program will begin “executing” your script file, reading one line at a time with the line delay you specified and the flow device will respond by sending one line of data for each poll it receives, when it receives it.

You can also capture the data to another file as described in the manual under “Collecting Data”. You will be simultaneously sending it a script file and capturing the output to a separate file for analysis.

Operating Principle

All M-Series Gas Flow Meters (and MC Series Gas Flow Controllers) are based on the accurate measurement of volumetric flow. The volumetric flow rate is determined by creating a pressure drop across a unique internal restriction, known as a Laminar Flow Element (LFE), and measuring differential pressure across it. The restriction is designed so that the gas molecules are forced to move in parallel paths along the entire length of the passage; hence laminar (streamline) flow is established for the entire range of operation of the device. Unlike other flow measuring devices, in laminar flow meters the relationship between pressure drop and flow is linear.

Please visit the Alicat web site for a detailed explanation this principle. http://www.alicat.com/technical-information/theory-of-operation/

STANDARD GAS DATA TABLES: Those of you who have older Alicat products (manufactured before October 2005) may notice small discrepancies between the gas property tables of your old and new units. Alicat Scientific, Inc. has incorporated the latest data sets from NIST (including their REFPROP 7 data) in our products’ built-in gas property models. Be aware that the calibrators that you may be using may be checking against older data sets such as the widely distributed Air Liquide data. This may generate apparent calibration discrepancies of up to 0.6% of reading on well behaved gases and as much as 3% of reading on some gases such as propane and butane, unless the standard was directly calibrated on the gas in question.

As the older standards are phased out, this difference in readings will cease to be a problem. If you see a difference between the Alicat meter and your in-house standard, in addition to calling Alicat Scientific at (520) 290-6060, call the manufacturer of your standard for clarification as to which data set they used in their calibration. This comparison will in all likelihood resolve the problem.

Gas Number	Short Form	Long Form	Viscosity* 25 deg C 14.696 psia	Density** 25 deg C 14.696 psia	Compressibility 25 deg C 14.696 psia
0	Air	Air	184.918	1.1840	0.9997
1	Ar	Argon	225.593	1.6339	0.9994
2	CH4	Methane	111.852	0.6569	0.9982
3	CO	Carbon Monoxide	176.473	1.1453	0.9997
4	CO2	Carbon Dioxide	149.332	1.8080	0.9949
5	C2H6	Ethane	93.540	1.2385	0.9924
6	H2	Hydrogen	89.153	0.08235	1.0006
7	He	Helium	198.457	0.16353	1.0005
8	N2	Nitrogen	178.120	1.1453	0.9998
9	N2O	Nitrous Oxide	148.456	1.8088	0.9946
10	Ne	Neon	311.149	0.8246	1.0005
11	O2	Oxygen	204.591	1.3088	0.9994
12	C3H8	Propane	81.458	1.8316	0.9841
13	n-C4H10	normal-Butane	74.052	2.4494	0.9699
14	C2H2	Acetylene	104.448	1.0720	0.9928
15	C2H4	Ethylene	103.177	1.1533	0.9943
16	i-C4H10	iso-Butane	74.988	2.4403	0.9728
17	Kr	Krypton	251.342	3.4274	0.9994
18	Xe	Xenon	229.785	5.3954	0.9947
19	SF6	Sulfur Hexafluoride	153.532	6.0380	0.9887
20	C-25	75% Argon / 25% CO2	205.615	1.6766	0.9987
21	C-10	90% Argon / 10% CO2	217.529	1.6509	0.9991
22	C-8	92% Argon / 8% CO2	219.134	1.6475	0.9992
23	C-2	98% Argon / 2% CO2	223.973	1.6373	0.9993
24	C-75	75% CO2 / 25% Argon	167.451	1.7634	0.9966
25	A-75	75% Argon / 25% Helium	230.998	1.2660	0.9997
26	A-25	75% Helium / 25% Argon	234.306	0.5306	1.0002
27	A1025	90% Helium / 7.5% Argon / 2.5% CO2 (Praxair - Helistar® A1025)	214.840	0.3146	1.0003
28	Star29	90% Argon / 8% CO2 / 2% Oxygen (Praxair - Stargon® CS)	218.817	1.6410	0.9992
29	P-5	95% Argon / 5% Methane	223.483	1.5850	0.9993
*in micropoise (1 Poise = gram / (cm) (sec)) ** Grams/Liter (NIST REFPROP 7 database)					

Gas Viscosities, Densities and Compressibilities at 25° C

Gas Number	Short Form	Long Form	Viscosity* 0 deg C 14.696 psia	Density** 0 deg C 14.696 psia	Compressibility 0 deg C 14.696 psia
0	Air	Air	172.588	1.2927	0.9994
1	Ar	Argon	209.566	1.7840	0.9991
2	CH4	Methane	103.657	0.7175	0.9976
3	CO	Carbon Monoxide	165.130	1.2505	0.9994
4	CO2	Carbon Dioxide	137.129	1.9768	0.9933
5	C2H6	Ethane	86.127	1.3551	0.9900
6	H2	Hydrogen	83.970	0.08988	1.0007
7	He	Helium	186.945	0.17849	1.0005
8	N2	Nitrogen	166.371	1.2504	0.9995
9	N2O	Nitrous Oxide	136.350	1.9778	0.9928
10	Ne	Neon	293.825	0.8999	1.0005
11	O2	Oxygen	190.555	1.4290	0.9990
12	C3H8	Propane	74.687	2.0101	0.9787
13	n-C4H10	normal-Butane	67.691	2.7048	0.9587
14	C2H2	Acetylene	97.374	1.1728	0.9905
15	C2H4	Ethylene	94.690	1.2611	0.9925
16	i-C4H10	iso-Butane	68.759	2.6893	0.9627
17	Kr	Krypton	232.175	3.7422	0.9991
18	Xe	Xenon	212.085	5.8988	0.9931
19	SF6	Sulfur Hexafluoride	140.890	6.6154	0.9850
20	C-25	75% Argon / 25% CO2	190.579	1.8309	0.9982
21	C-10	90% Argon / 10% CO2	201.897	1.8027	0.9987
22	C-8	92% Argon / 8% CO2	203.423	1.7989	0.9988
23	C-2	98% Argon / 2% CO2	208.022	1.7877	0.9990
24	C-75	75% CO2 / 25% Argon	154.328	1.9270	0.9954
25	A-75	75% Argon / 25% Helium	214.808	1.3821	0.9995
26	A-25	75% Helium / 25% Argon	218.962	0.5794	1.0002
27	A1025	90% Helium / 7.5% Argon / 2.5% CO2 (Praxair - Helistar® A1025)	201.284	0.3434	1.0002
28	Star29	90% Argon / 8% CO2 / 2% Oxygen (Praxair - Stargon® CS)	203.139	1.7918	0.9988
29	P-5	95% Argon / 5% Methane	207.633	1.7307	0.9990
*in micropoise (1 Poise = gram / (cm) (sec)) ** Grams/Liter (NIST REFPROP 7 database)					

Gas Viscosities, Densities and Compressibilities at 0° C

TROUBLESHOOTING

Display does not come on or is weak.
Check power and ground connections. Please reference the technical specifications (pages 34-48) to assure you have the proper power for your model.

Flow reading is approximately fixed either near zero or near full scale regardless of actual line flow.
Differential pressure sensor may be damaged. Avoid installations that can subject sensor to pressure drops in excess of 10 psid. A common cause of this problem is instantaneous application of high-pressure gas as from a snap acting solenoid valve upstream of the meter. If you suspect that your pressure sensor is damaged please discontinue use of the meter and contact Alicat.

Displayed mass flow, volumetric flow, pressure or temperature is flashing and message MOV, VOV, POV or TOV is displayed:
Our flow meters and controllers display an error message (MOV = mass overrange, VOV = volumetric overrange, POV = pressure overrange, TOV = temperature overrange) when a measured parameter exceeds the range of the sensors in the device. When any item flashes on the display, neither the flashing parameter nor the mass flow measurement is accurate. Reducing the value of the flashing parameter to within specified limits will return the unit to normal operation and accuracy. If the unit does not return to normal contact Alicat.

Meter reads negative flow when there is a confirmed no flow condition.
This is an indication of an improper tare. If the meter is tared while there is flow, that flow is accepted as zero flow. When an actual zero flow condition exists, the meter will read a negative flow. Simply re-tare at the confirmed zero flow condition. Also note that while the meter is intended for positive flow, it will read negative flow with reasonable accuracy, but not to the full scale flow rate (it is not calibrated for bi-directional flow) and no damage will result.

Meter does not agree with another meter I have in line.
Volumetric meters are affected by pressure drops. Volumetric flow meters should not be compared to mass flow meters. Mass flow meters can be compared against one another provided there are no leaks between the two meters and they are set to the same standard temperature and pressure. Both meters must also be calibrated (or set) for the gas being measured. M-Series mass flow meters are normally set to Standard Temperature and Pressure conditions of 25° C and 14.696 psia. Note: it is possible to special order meters with a customer specified set of standard conditions. The calibration sheet provided with each meter lists its standard conditions.
When performing this comparison it is best to use the smallest transition possible between the two devices. Using small transitions will minimize lag and dead volume.

Flow flutters or is jumpy.
The meters are very fast and will pick up any actual flow fluctuations such as from a diaphragm pump, etc. Also, inspect the inside of the upstream connection for debris such a Teflon tape shreds.
Note: M-Series meters feature a programmable geometric running average (GRA) that can aid in allowing a rapidly fluctuating flow to be read (see "Pressure Averaging" and "Flow Averaging" page 20).

The output signal is lower than the reading at the display.
This can occur if the output signal is measured some distance from the meter, as voltage drops in the wires increase with distance. Using heavier gauge wires, especially in the ground wire, can reduce this effect.

RS-232 / RS-485 Serial Communications is not responding.
Check that your meter is powered and connected properly. Be sure that the port on the computer to which the meter is connected is active. Confirm that the port settings are correct per the RS-232 instructions in this manual (Check the RS-232 / RS-485 communications select screen for current meter readings). Close Hyperterminal® and reopen it. Reboot your PC. See pages 10, 11 and 22 for more information on RS-232 / RS-485 signals and communications.

Slower response than specified.
M-Series Meters feature a programmable Geometric Running Average (GRA). Depending on the full scale range of the meter, it may have the GRA set to enhance the stability/readability of the display, which would result in slower perceived response time. Please see "Pressure Averaging" and "Flow Averaging" on page 20.

Jumps to zero at low flow.
M-Series Meters feature a programmable zero deadband. The factory setting is usually 0.5% of full scale. This can be adjusted between NONE and 3.2% of full scale. See page 20.

Discrepancies between old and new units.
Please see "Standard Gas Data Tables" explanation on page 28.

Maintenance and Recalibration

General: M-Series Flow Meters require minimal maintenance. They have no moving parts. The single most important thing that affects the life and accuracy of these devices is the quality of the gas being measured. The meter is designed to measure CLEAN, DRY, NON-CORROSIVE gases.

Moisture, oil and other contaminants can affect the laminar flow elements. We recommend the use of in-line sintered filters to prevent large particulates from entering the measurement head of the instrument. Suggested maximum particulate sizes are as follows:

5 microns for units with FS flow ranges of 0-1 sccm or less.
20 microns for units with FS flow ranges between 0-2 sccm and 0-1 slpm.
50 microns for units with FS flow ranges of 0-1 slpm or more.

Recalibration: The recommended period for recalibration is once every year. A label located on the back of the meter lists the most recent calibration date. The meter should be returned to the factory for recalibration within one year from the listed date. Before calling to schedule a recalibration, please note the serial number on the back of the meter. The Serial Number, Model Number, and Date of Manufacture are also available on the Model Info display (page 21).

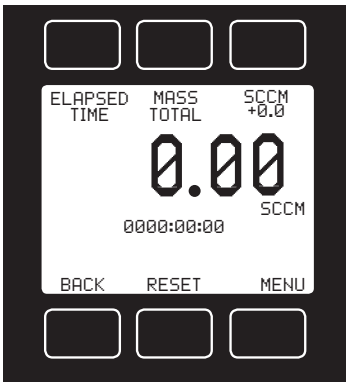
Cleaning: M-Series Flow Meters require no periodic cleaning. If necessary, the outside of the meter can be cleaned with a soft dry cloth. Avoid excess moisture or solvents.

For repair, recalibration or recycling of this product contact:

Alicat Scientific, Inc.
7641 N Business Park Drive
Tucson, Arizona 85743
USA
Phone: 520-290-6060
Fax: 520-290-0109
e-mail: info@alicat.com
Web site: www.alicat.com

Option: Totalizing Mode

Meters and Controllers can be purchased with the Totalizing Mode option. This option adds an additional mode screen that displays the total flow (normally in the units of the main flow screen) that has passed through the device since the last time the totalizer was cleared.



The Totalizing Mode screen is accessed by pushing the TOTAL button on the MAIN display.

MASS TOTAL – The counter can have as many as seven digits. At the time of order, the customer must specify the range. This directly affects the maximum count. For instance, if a range of 1/100ths of a liter is specified on a meter which is totalizing in liters, the maximum count would be 99999.99 liters. If the same unit were specified with a 1 liter range, the maximum count would be 9999999 liters.

Rollover – The customer can also specify at the time of order what the totalizer is to do when the maximum count is reached. The following options may be specified:

No Rollover – When the counter reaches the maximum count it stops counting until the counter is cleared.

Rollover – When the counter reaches the maximum count it automatically rolls over to zero and continues counting until the counter is cleared.

Rollover with Notification – When the counter reaches the maximum count it automatically rolls over to zero, displays an overflow error, and continues counting until the counter is cleared.

ELAPSED TIME: The small numbers below the mass total show the elapsed time since the last reset in hours, minutes and seconds. The maximum measurable elapsed time is 9999 hours 59 minutes 59 seconds. The hours count resets when RESET is pushed, an RS-232 or RS-485 clear is executed or on loss of power. Press ELAPSED TIME to show this as the primary display.

RESET – The counter can be reset to zero at any time by pushing the RESET button. To clear the counter via RS-232 or RS-485, establish serial communication with the meter or controller as described in the RS-232 or RS-485 section of the manual. To reset the counter, enter the following commands:

In Polling (addressable) Mode: Address$$T <Enter> (e.g. B$$T <Enter>)

Alicat Portable Meters and Gauges

Alicat Portable Flow Meters and Gauges use a common 9 Volt battery located in the top section of your meter.

Output signals from the flow meter are passed through the female connector on top of the flow meter. Turn the switch on top of the flow meter “off” when the meter is not in use.

Normal (9V alkaline) battery life is approximately 8 hours (30-40 hours with a 9V-lithium battery), however many factors can affect this.

Note: Alicat recommends the use of non-rechargeable 9V-lithium batteries in all MB TFT (color display portable) meters and gauges.

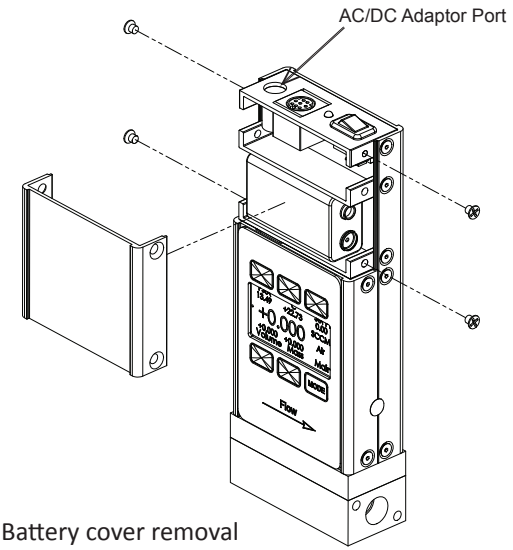
Replace the battery as often as required. A yellow LED indicates low voltage and that the battery should be replaced.

A false signal can result when the voltage drops below its normally regulated level.

Alicat Portable Flow Meters and Gauges can also be powered by an optional AC/DC plug-in wall adaptor. With the adaptor plugged into the flow meter, the battery is bypassed and the meter will operate solely off the adaptor power supply.

Replacing the Battery:

1. Remove the four Phillips head screws from the front cover and gently remove it as shown below.
2. Remove the 9V battery, pulling the top of the battery out first.
3. Disconnect the old battery from the harness and replace it with a new battery.
4. Install the new battery bottom end first and replace the back cover so that the cushioning pad presses directly down on the battery.
5. Replace the four Phillips head screws.



Battery cover removal

Option: Remote Electronics for High Line or Gas Temperatures

Some applications involve operating temperatures outside the standard Alicat device specifications. A solution using remote electronics is available. (This option is not applicable for liquid devices.)

The flow body's components are minimized to only the required sensors. The flow data is sent to the microprocessor electronics up to 6 feet away from the sensor package.

Relocating the sensitive electronics allows for installation of the flow body in ambient temperatures as high as 85° Celsius with gas temperatures under 100°Celsius.

In these applications we recommend our custom gauge calibration at a gas temperature of up to 70°Celsius. This will reduce zero shift errors that occur when actual gas flow temperatures deviate substantially from the gas calibration temperature.

This configuration is also used in integrations that require a compact flow package at the installation point.

Option: Remote Panel Display

Our Remote Display option offers the flexibility of using Alicat's display with units that are embedded inside processes or instrument enclosures.

The Remote Display retains all of the same features as our standard display.

The Remote Display is ideal for:

- OEMs Remote Panel Mounting
- Gas Panels
- Leak Detection Systems
- Embedded Systems
- Fuel Cell Test Stations
- Artificial Environments

Accessory: BB9 Multi-Drop Box

The **BB9 Multi-Drop Box** makes it convenient to wire multiple flow and/or pressure devices to a single RS-232 or RS-485 port. ***Now available with a USB interface!***

The Multi-Drop Box has nine 8 pin mini-DIN ports available. The ports are to be used with a standard double ended 8 pin mini-DIN (DC-62) style cable going from the box to each flow or pressure device.

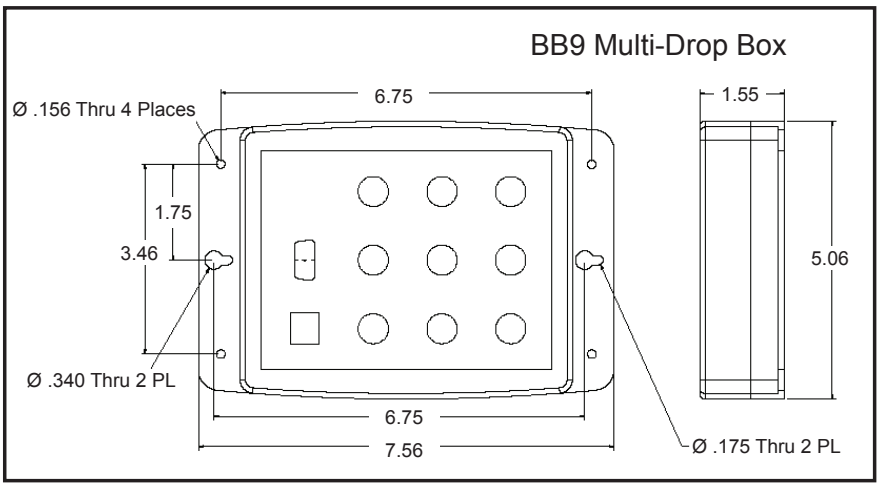
A single DB9 D-SUB type connector (COM PORT) connects, using the included cable, to the serial connector on a PC or laptop.

All of the flow and/or pressure devices are powered via a terminal block on the front of the box.

If more than nine devices will be required, additional Multi-Drop Boxes can be daisy chained together with a double ended 8 pin mini-DIN cable plugged into any receptacle on both boxes.

BB9 Power Supply for Large Valve Controllers: The PS24VHC (Power Supply 24Vdc High Current) is a 6.5Amp 24Vdc power supply designed for running multiple large controllers on a BB9.

The 6.5Amp power supply can run as many as 8 large valve controllers, which makes it ideal for the BB9 and multiple large valve (or small valve / large valve combination) controllers on a BB9.



Accessory: Flow Vision™ SC Software

Flow Vision™ SC is an intuitive software interface to help your test cycles run smoother and shorten your engineering time!

Flow Vision™ SC lets you connect to and communicate with multiple Alicat units simultaneously. Now you can view virtual displays, control tabs, charts and data lines from every connected Alicat device on the same screen.

Flow Vision™ SC supports all RS-232 and RS-485 Serial communication functions, including: **gas selection, tareing, set-point control, valve tuning and flow averaging.**

Session Saving: Save and reload your configuration data with confidence.

Script Building: Create scripts to adjust a controller's set-point value at variable specified time intervals.

Charting: Chart as many parameters as you want off as many devices as you want, with color coding, zooming, and printing functionality.

Alarms: Create software alarms that will notify you of given parameter conditions.

Data Capture & Logging: Capture and log data to either a .csv file or a .txt file. Improved Data Logging and Data Log File Splitting for easy to manage data.

Accessory: Flow Vision™ MX Software

Alicat's New Flow Vision™ MX software gives you an easy way to do GAS BLENDING using Alicat Mass Flow Controllers and your own PC.

Flow Vision™ MX software is a simple way to connect up to six Alicat mass flow controllers and create your own gas mix concentrations.

Using our inexpensive ***BB9-USB*** and a single USB connection you can:

- **Create** your own gas blends
- **Adjust** flow rates
- **Save** your specific blend formulas.

All the controllers can be powered through the BB9-USB with a single power supply.

Just connect your unique gases to each controller, select the gas type either locally on the controller or through Flow Vision™ MX, manifold the flow outputs and create your gas mix.

Accessories

Part Number	Description
FLOWVISIONSC	Flow Vision™ SC software for interface with all Alicat instruments
FLOWVISIONMX	Flow Vision™ MX software for gas blending
BB9	9 position Multi-Drop Box
BB9-I	9 position Multi-Drop Box, Industrial connectors
PVPS24U	Universal 100-240 VAC to 24 Volt DC Power Supply Adapter
PS24VHC	High current power supply for BB9 use with Large Valve Controllers
PCASE	Industrial carry and storage case for portable meters/gauges
DC-61	8 Pin Male Mini-DIN connector cable, single ended, 6 foot length
DC-251	8 Pin Male Mini-DIN connector cable, single ended, 25 foot length
DC-301	8 Pin Male Mini-DIN connector cable, single ended, 30 foot length
DC-501	8 Pin Male Mini-DIN connector cable, single ended, 50 foot length
DC-751	8 Pin Male Mini-DIN connector cable, single ended, 75 foot length
DC-6RT	8 Pin Male Right Angle Mini-Din Cable, single ended, 6 foot length
DC-62	8 Pin Male Mini-DIN connector cable, double ended, 6 foot length
DC-252	8 Pin Male Mini-DIN connector cable, double ended, 25 foot length
DC-502	8 Pin Male Mini-DIN connector cable, double ended, 50 foot length
DC-602	8 Pin Male Mini-DIN connector cable, double ended, 60 foot length
MD8DB9	8 Pin Male Mini-DIN to DB9 Female Adapter, 6 foot length
DBC-251	DB15 cable, single ended, 25 foot length
510199	DB9 cable, double-ended female, 3 meter length
IC10	Industrial cable, 6 Pin, single ended, 10 foot length
IC10-18G	18 gauge industrial cable, 6 Pin, single ended, 10 foot length
IC20	Industrial cable, 6 Pin, single ended, 20 foot length
IC24-18G	18 gauge industrial cable, 6 Pin, single ended, 24 foot length
IC50	Industrial cable, 6 Pin, single ended, 50 foot length
IC-102	Industrial cable, 6 pin double ended, 10 foot length
USB-RS232	RS-232 to USB Converter

Accessories

MNPT to Compression Fittings	
10-32 - 1/8”	SS-200-1-0157
10-32 - 1/4”	SS-400-1-0256
1/8” - 1/8”	SS-200-1-2
1/8” - 1/4”	SS-400-1-2
1/8” - 3/8”	SS-600-1-2
1/8” - 1/2”	SS-810-1-2
1/8” - 3mm	SS-3M0-1-2
1/8” - 4mm	SS-4M0-1-2
1/8” - 6mm	SS-6M0-1-2
1/8” - 8mm	SS-8M0-1-2
1/8” - 12mm	SS-12M0-1-2
1/4” - 1/8”	SS-200-1-4
1/4” - 1/4”	SS-400-1-4
1/4” - 3/8”	SS-600-1-4
1/4” - 1/2”	SS-810-1-4
1/4” - 3mm	SS-3M0-1-4
1/4” - 4mm	SS-4M0-1-4
1/4” - 6mm	SS-6M0-1-4
1/4” - 8mm	SS-8M0-1-4
1/4” - 12mm	SS-12M0-1-4
1/2” - 1/8”	SS-200-1-8
1/2” - 1/4”	SS-400-1-8
1/2” - 3/8”	SS-600-1-8
1/2” - 1/2”	SS-810-1-8
1/2” - 3/4”	SS-1210-1-8
1/2” - 6mm	SS-6M0-1-8
1/2” - 8mm	SS-8M0-1-8
1/2” - 12mm	SS-12M0-1-8
1/2” - 16mm	SS-16M0-1-8
3/4” - 1/4”	SS-400-1-12
3/4” - 1/2”	SS-810-1-12
3/4” - 3/4”	SS-1210-1-12
3/4” - 12mm	SS-12M0-1-12
3/4” - 16mm	SS-16M0-1-12

Filters & Elements FNPT-MNPT	
10-32 5µ	510053
10-32 20µ	510054
1/8” 20µ	ILF-1/8-20
1/4” 40µ	ILF-1/4-40
1/2” 40µ	ILF-1/2-40*
3/4” 40µ	ILF-3/4-40*
20µ element	ILFE20
40µ element	ILFE40
40µ element	ILFE40L*

Filters & Elements FNPT-FNPT*	
10-32 5µ	CF-303-20-316
*requires MNPT to MNPT coupler to interface with Alicat flow bodies	

10-32 Male UNF to 1/8 FNPT Adapter
410133
Male M5 (10-32) Buna-N O-ring face seal to 1/8”Female NPT

Technical Data for Alicat M Mass Flow Meters
0 to 0.5 sccm Full Scale through 0 to 3000 slpm Full Scale

Standard Operating Specifications (Contact Alicat for available options)

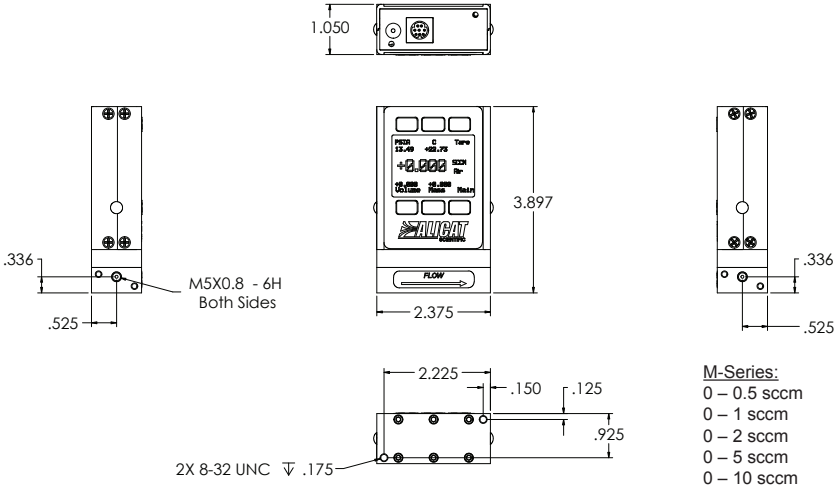
Performance	M-Series Mass Flow Meter
Accuracy at calibration conditions after tare	± (0.8% of Reading + 0.2% of Full Scale)
High Accuracy at calibration conditions after tare	± (0.4% of Reading + 0.2% of Full Scale) High Accuracy option not available for units ranged under 5 sccm or over 500 slpm.
Accuracy for Bidirectional Meters at calibration conditions after tare	± (0.8% of reading + 0.2% of total span from positive full scale to negative full scale)
Repeatability	± 0.2% Full Scale
Zero Shift and Span Shift	0.02% Full Scale / ºCelsius / Atm
Operating Range / Turndown Ratio	0.5% to 100% Full Scale / 200:1 Turndown
Maximum Measurable Flow Rate	128% Full Scale
Typical Response Time	10 ms (Adjustable)
Warm-up Time	< 1 Second
Operating Conditions	**M-Series Mass Flow Meter**
Mass Reference Conditions (STP)	25ºC & 14.696 psia (standard — others available on request)
Operating Temperature	−10 to +50 ºCelsius
Humidity Range (Non–Condensing)	0 to 100%
Maximum Pressure	145 psig
Mounting Attitude Sensitivity	None
Ingress Protection	IP40
Wetted Materials	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum If your application demands a different material, please contact Alicat.
Communications / Power	**M-Series Mass Flow Meter**
Monochrome LCD or Color TFT Display with integrated touchpad	Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature
Digital Output Signal[1] Options	RS-232 Serial / RS-485 Serial / PROFIBUS[3]
Analog Output Signal[2] Options	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Optional Secondary Analog Output Signal[2]	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Electrical Connection Options	8 Pin Mini-DIN / 9-pin D-sub (DB9) / 15-pin D-sub (DB15) / 6 pin locking
Supply Voltage	7 to 30 Vdc (15-30 Vdc for 4-20 mA outputs)
Supply Current	0.040 Amp (+ output current on 4-20 mA)

1. The **Digital Output Signal** communicates Mass Flow, Volumetric Flow, Pressure and Temperature
2. The **Analog Output Signal** and **Optional Secondary Analog Output Signal** communicate your choice of Mass Flow, Volumetric Flow, Pressure or Temperature
3. If selecting **PROFIBUS**, no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents (page 48).

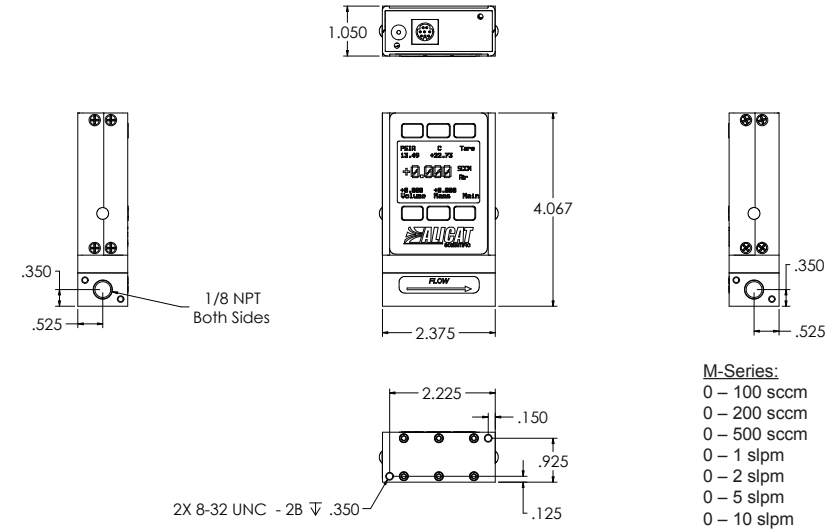
Range Specific Specifications

Full Scale Flow Mass Meter	Pressure Drop at FS Flow (psid) venting to atmosphere[1]	Mechanical Dimensions	Process Connections[2]
0.5 sccm to 1 sccm	1.0	3.9"H x 2.4"W x 1.1"D	M-5 (10-32) Female Thread[3]
2 sccm to 50 sccm	1.0		
100 sccm to 20 slpm	1.0	4.1"H x 2.4"W x 1.1"D	1/8" NPT Female
50 slpm	2.0	4.4"H x 4.0"W x 1.6"D	1/4" NPT Female
100 slpm	2.5		
250 slpm	2.1	5.0"H x 4.0"W x 1.6"D	1/2" NPT Female
500 slpm	4.0	5.0"H x 4.0"W x 1.6"D	3/4" NPT Female (A 1-1/4" NPT Female optional process connection is available for 2000 slpm meters.)
1000 slpm	6.0		
1500 slpm	9.0		
2000 slpm	5.0	5.3"H x 5.2"W x 2.9"D	
3000 slpm	7.1	5.3"H x 5.2"W x 2.9"D	1-1/4" NPT Female

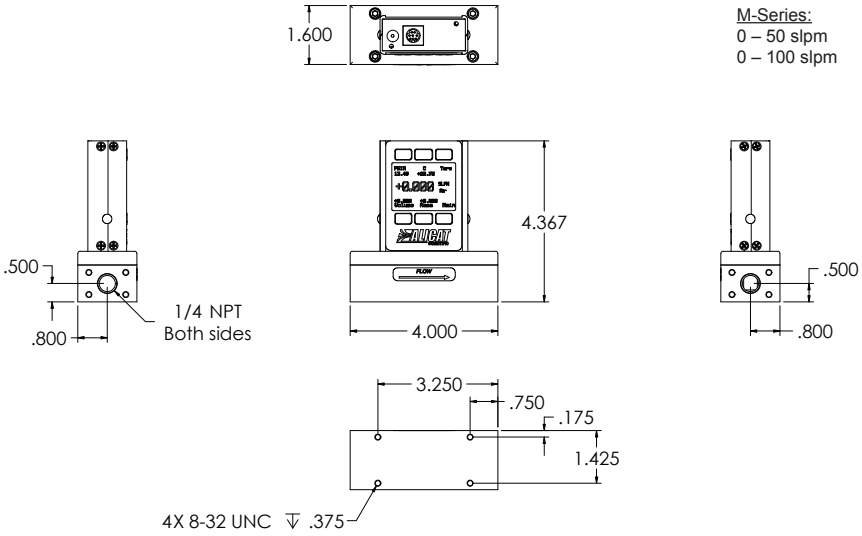
1. Lower Pressure Drops Available, please see our **WHISPER-Series** mass flow controllers at ***www.alicat.com/whisper***.
2. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. VCR and SAE connections upon request.
3. Shipped with M-5 (10-32) Male Buna-N O-ring face seal to 1/8" Female NPT fittings.

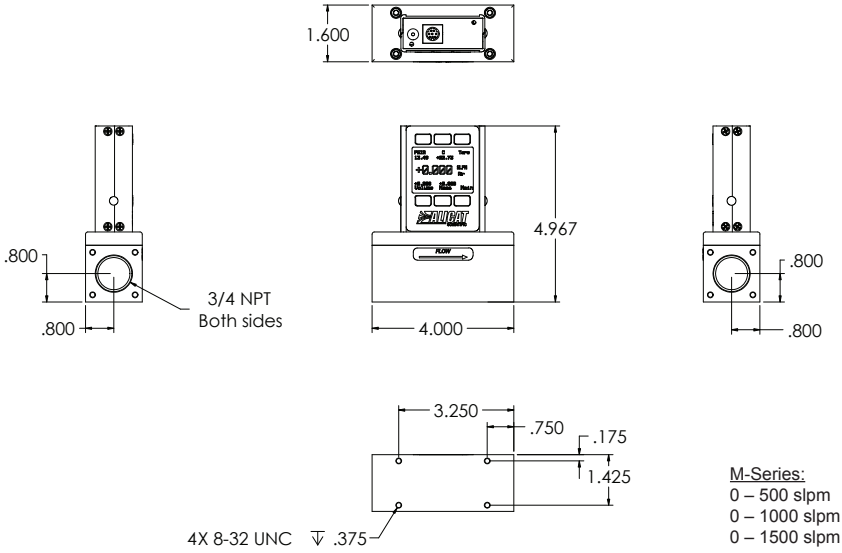


M-Series:
0 – 0.5 sccm
0 – 1 sccm
0 – 2 sccm
0 – 5 sccm
0 – 10 sccm
0 – 20 sccm
0 – 50 sccm

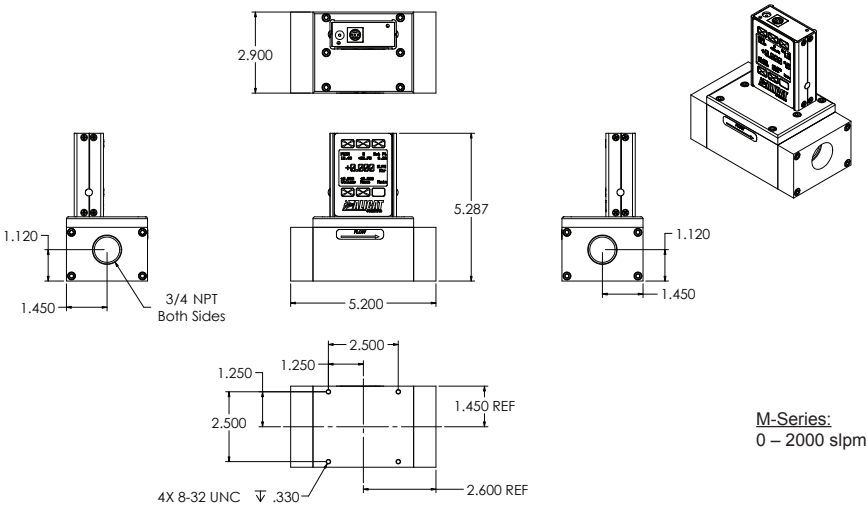


M-Series:
0 – 100 sccm
0 – 200 sccm
0 – 500 sccm
0 – 1 slpm
0 – 2 slpm
0 – 5 slpm
0 – 10 slpm
0 – 20 slpm

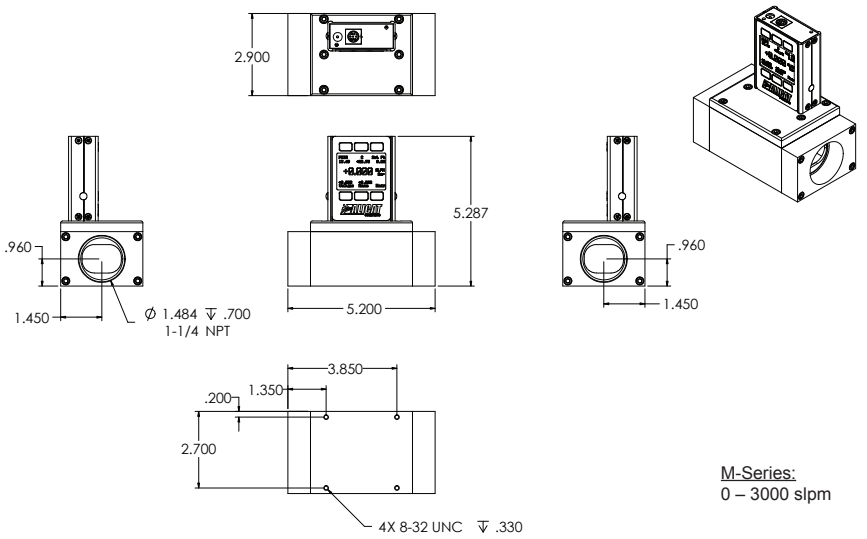

1.600
M-Series:
0 – 50 slpm
0 – 100 slpm
.500
.800
1/4 NPT
Both sides
4.367
4.000
.500
.800
3.250
.750
.175
1.425
4X 8-32 UNC ↧ .375
1.600
4.000
M-Series:
0 – 250 slpm
.800
.800
1/2 NPT
Both Sides
4.967
.800
.800
3.250
.750
.175
1.425
4X 8-32 UNC ↧ .375



M-Series:
0 – 500 slpm
0 – 1000 slpm
0 – 1500 slpm



M-Series:
0 – 2000 slpm



M-Series:
0 – 3000 slpm

Technical Data for WHISPER Low Pressure Drop Mass Flow Meters
0 to 0.5 sccm Full Scale through 0 to 500 slpm Full Scale

Standard Operating Specifications (Contact Alicat for available options.)

Performance	Whisper Mass Flow Meter
Accuracy at calibration conditions after tare	± (0.8% of Reading + 0.2% of Full Scale)
High Accuracy at calibration conditions after tare	± (0.4% of Reading + 0.2% of Full Scale) High Accuracy option not available for units ranged under 5 sccm or over 500 slpm.
Accuracy for Bidirectional Meters at calibration conditions after tare	± (0.8% of reading + 0.2% of total span from positive full scale to negative full scale)
Repeatability	± 0.2% Full Scale
Zero Shift and Span Shift	0.02% Full Scale / ºCelsius / Atm
Operating Range / Turndown Ratio	0.5% to 100% Full Scale / 200:1 Turndown
Maximum Measurable Flow Rate	128% Full Scale
Typical Response Time	10 ms (Adjustable)
Warm-up Time	< 1 Second
Operating Conditions	**Whisper Mass Flow Meter**
Mass Reference Conditions (STP)	25ºC & 14.696 psia (standard — others available on request)
Operating Temperature	−10 to +50 ºCelsius
Humidity Range (Non–Condensing)	0 to 100%
Maximum Pressure	50 psig[1] Higher line pressures available, please contact Alicat.
Mounting Attitude Sensitivity	None
Ingress Protection	IP40
Wetted Materials	303 & 302 Stainless Steel, Viton®, Silicone RTV (Rubber), Glass Reinforced Nylon, Aluminum If your application demands a different material, please contact Alicat.

1. Do Not subject a WHISPER Differential Pressure sensor to upstream-downstream pressure differentials exceeding 15 PSID.

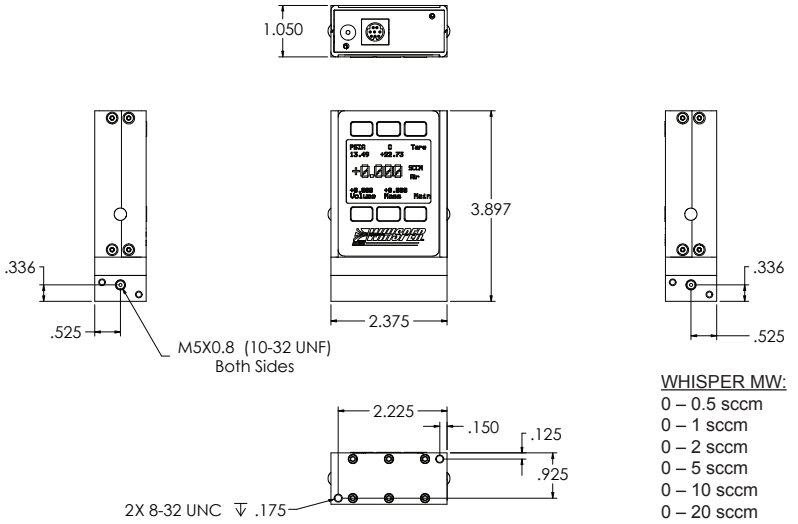
Communications / Power	Whisper Mass Flow Meter
Monochrome LCD or Color TFT Display with integrated touchpad	Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature
Digital Output Signal[1] Options	RS-232 Serial / RS-485 Serial / PROFIBUS[3]
Analog Output Signal[2] Options	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Optional Secondary Analog Output Signal[2]	0-5 Vdc / 1-5 Vdc / 0-10 Vdc / 4-20 mA
Electrical Connection Options	8 Pin Mini-DIN / 9-pin D-sub (DB9) / 15-pin D-sub (DB15) / 6 pin locking
Supply Voltage	7 to 30 Vdc (15-30 Vdc for 4-20 mA outputs)
Supply Current	0.040 Amp (+ output current on 4-20 mA)

1. The **Digital Output Signal** communicates Mass Flow, Volumetric Flow, Pressure and Temperature
2. The **Analog Output Signal** and **Optional Secondary Analog Output Signal** communicate your choice of Mass Flow, Volumetric Flow, Pressure or Temperature
3. If selecting **PROFIBUS**, no analog signal is available. PROFIBUS units do not have the display. See PROFIBUS specifications for PROFIBUS supply voltages and currents (page 48) .

Range Specific Specifications

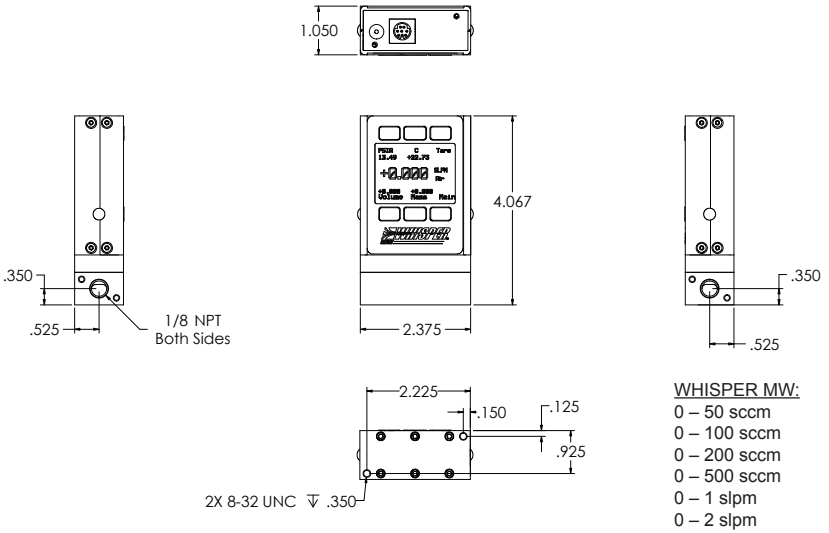
Full Scale Flow Mass Meter	Pressure Drop at FS Flow (psid)venting to atmosphere	Mechanical Dimensions	Process Connections[1]
0.5 sccm to 2 sccm	0.06	3.9"H x 2.4"W x 1.1"D	**M-5 (10-32) Female Thread[2]**
5 sccm to 20 sccm	0.07		
50 sccm	0.07	4.1"H x 2.4"W x 1.1"D	1/8" NPT Female
100 sccm to 200 sccm	0.06		
500 sccm	0.07		
1 slpm to 5 slpm	0.07		
10 slpm	0.08	4.4"H x 4.0"W x 1.6"D	1/4" NPT Female
20 slpm	0.25		
40 slpm	0.12	5.0"H x 4.0"W x 1.6"D	1/2" NPT Female
50 slpm	0.14	5.0"H x 4.0"W x 1.6"D	3/4" NPT Female
100 slpm	0.24		
250 slpm	0.60		
500 slpm	0.39	5.3"H x 5.2"W x 2.9"D	3/4" NPT Female

1. Compatible with Beswick®, Swagelok® tube, Parker®, face seal, push connect and compression adapter fittings. VCR and SAE connections upon request.
2. Shipped with M-5 (10-32) Male Buna-N O-ring face seal to 1/8" Female NPT fittings.



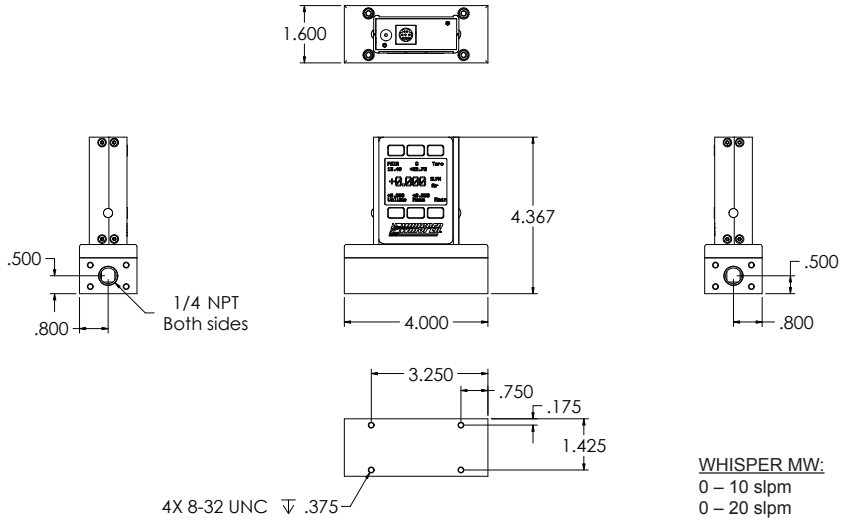
WHISPER MW:
0 – 0.5 sccm
0 – 1 sccm
0 – 2 sccm
0 – 5 sccm
0 – 10 sccm
0 – 20 sccm

MW 0.5 sccm to 20 sccm approximate shipping weight: 0.8lb

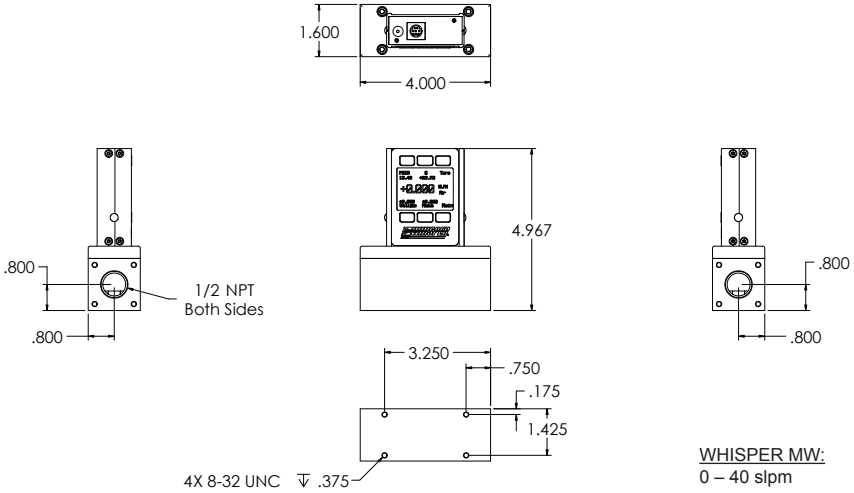


WHISPER MW:
0 – 50 sccm
0 – 100 sccm
0 – 200 sccm
0 – 500 sccm
0 – 1 slpm
0 – 2 slpm
0 – 5 slpm

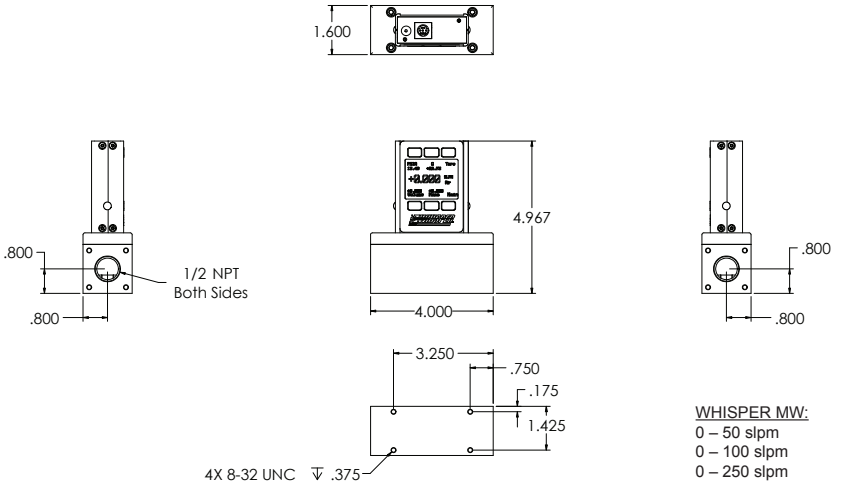
MW 50 sccm to 5 slpm approximate shipping weight: 1.0lb



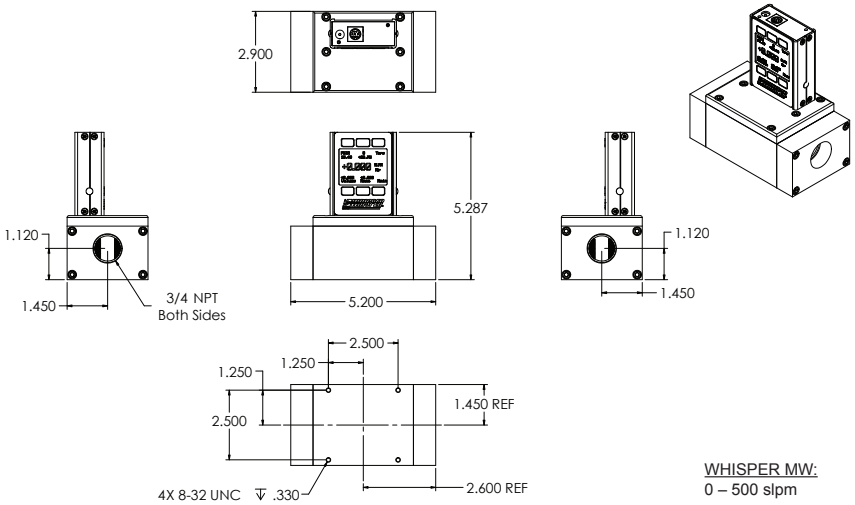
MW 10 slpm to 20 slpm approximate shipping weight: 2.4 lb.



MW 40 slpm approximate shipping weight: 3.2 lb.



MW 50 slpm to 250 slpm approximate shipping weight: 3.5lb



MW 500 slpm approximate shipping weight: 4.5lb

Technical Data for Alicat MS-Series Mass Flow Meters

Alicat MS instruments are built for use with aggressive gases. For the most part, these instruments maintain the specifications of equivalently ranged M-Series devices.

Standard Compatible Gas List for MS-Series Meters

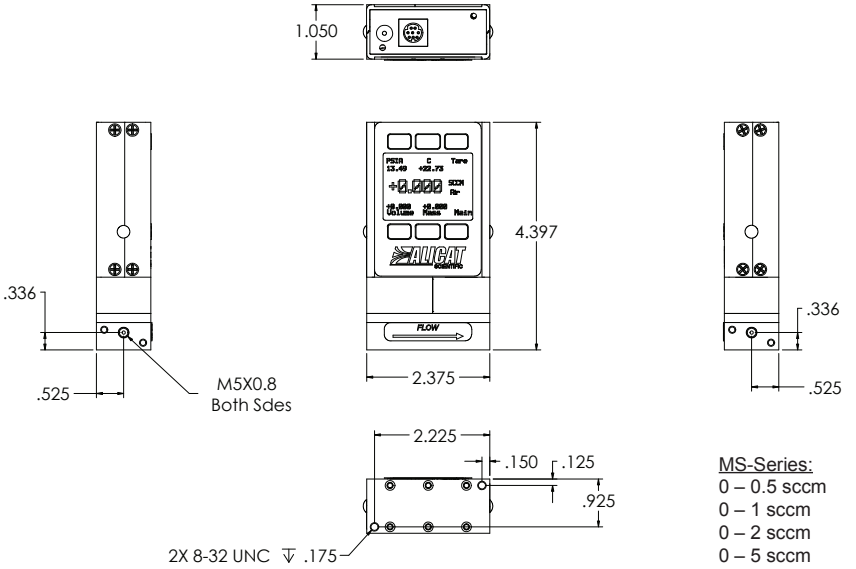
0	Air	Air
1	Argon	Ar
2	Methane	CH4
3	Carbon Monoxide	CO
4	Carbon Dioxide	CO2
5	Ethane	C2H6
6	Hydrogen	H2
7	Helium	He
8	Nitrogen	N2
9	Nitrous Oxide	N2O
10	Neon	Ne
11	Oxygen	O2
12	Propane	C3H8
13	normal-Butane	n-C4H10
14	Acetylene	C2H2
15	Ethylene	C2H4
16	iso-Butane	i-C4H10
17	Krypton	Kr
18	Xenon	Xe
19	Sulfur Hexafluoride	SF6
20	75%Ar / 25% CO2	C-25
21	90% Ar / 10% CO2	C-10
22	92% Ar / 8% CO2	C-8
23	98% Ar / 2% CO2	C-2
24	75% CO2 / 25% Ar	C-75
25	75% Ar / 25% He	A-75
26	75% He / 25% Ar	A-25
27	90% He / 7.5% Ar / 2.5% CO2 Helistar® A1025	A1025
28	90% Ar / 8% CO2 / 2% O2 Stargon® CS	Star29
29	95% Ar / 5% CH4	P-5
30	Nitric Oxide	NO
31	Nitrogen Triflouride	NF3
32	Ammonia	NH3
33	Chlorine Gas	Cl2
34	Hydrogen Sulfide	H2S
35	Sulfur Dioxide	SO2
36	Propylene	C3H6
In addition, the following gases are available upon request:		
Nitrogen Dioxide to 0.5% in an inert carrier		NO2
Refrigerant gases to 100%		

If your application requires another gas or gas mixture, please contact Info@alicat.com or call 888-290-6060. We will do our best to accommodate your request.

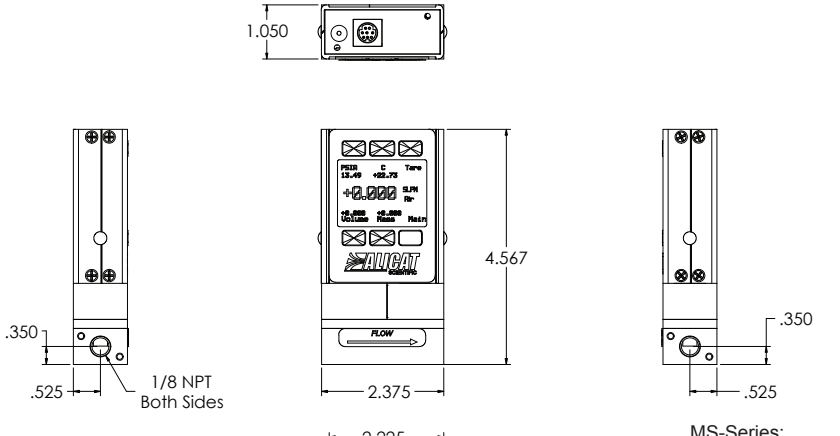
Please refer to the Technical Data for the equivalently ranged M-Series instrument for all operating specifications except:

Operating Range	1% to 100%	Full Scale
Turndown Ratio	100 : 1	
Wetted Materials	316LSS, FFKM (Kalrez) standard; Viton, EPDM, Buna, Neoprene as needed for some gases.	

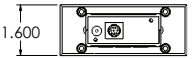
The dimensions of MS instruments may vary from their standard M-Series counterparts. Dimensional drawings for MS instruments are shown on pages 44-47.



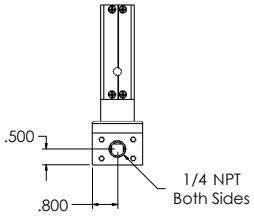
MS-Series:
0 – 0.5 sccm
0 – 1 sccm
0 – 2 sccm
0 – 5 sccm
0 – 10 sccm
0 – 20 sccm
0 – 50 sccm

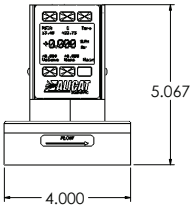


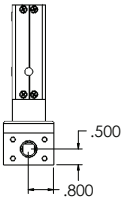
MS-Series:
0 – 100 sccm
0 – 200 sccm
0 – 500 sccm
0 – 1 slpm
0 – 2 slpm
0 – 5 slpm
0 – 10 slpm
0 – 20 slpm

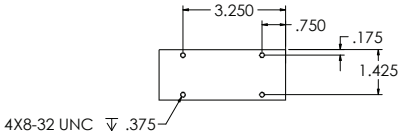


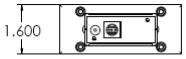
MS-Series:
0 – 50 slpm
0 – 100 slpm



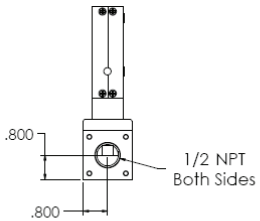


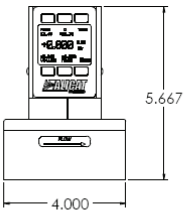


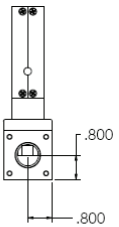


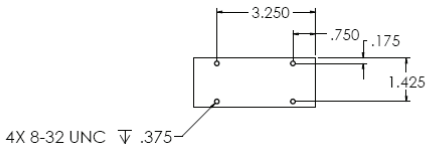


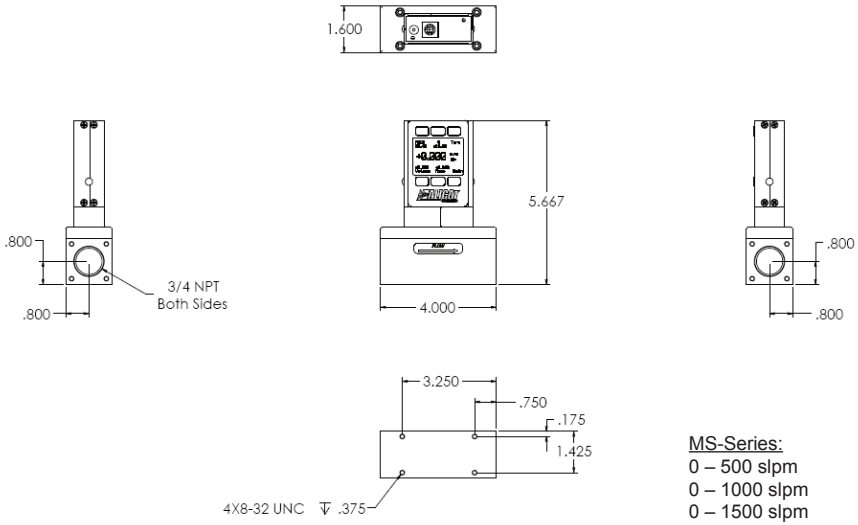
MS-Series:
0 – 250 slpm



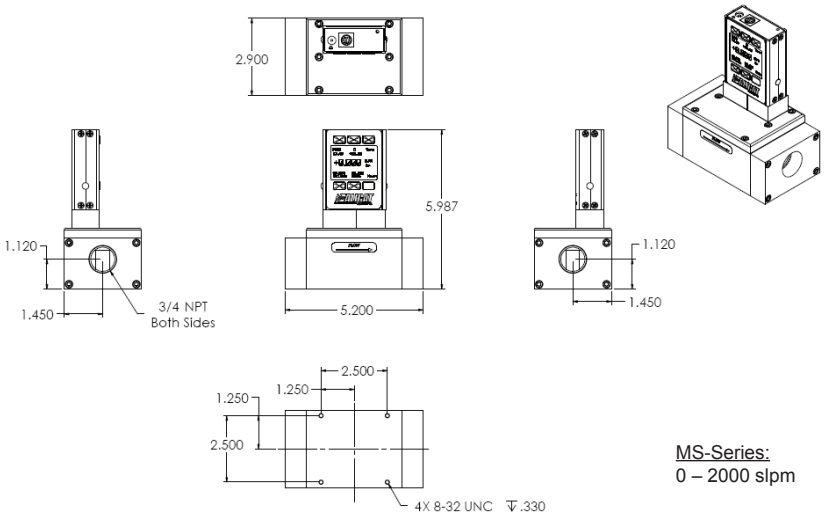




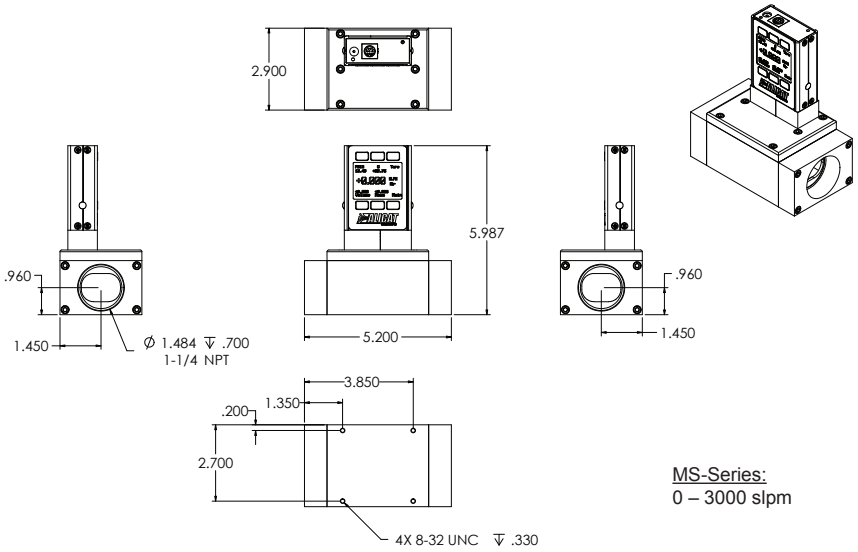




MS-Series:
0 – 500 slpm
0 – 1000 slpm
0 – 1500 slpm



MS-Series:
0 – 2000 slpm



MS-Series:
0 – 3000 slpm

NOTICE: The following specifications are applicable to Alicat PROFIBUS enabled meters, gauges and controllers only.

All other operating specifications are shown in the Technical Data page for standard Alicat instruments.

All standard device features and functions are available and operate in accordance with the standard Alicat Scientific device operating manual provided with the device.

Specification	Meter or Gauge	Small Valve Controller	Large Valve Controller	Description
Input /Output Signal Digital				PROFIBUS DP
Electrical Connections	DB9			
Supply Voltage:	7 to 30 Vdc	12 to 30 Vdc	24 to 30 Vdc	
Supply Current	80mA @ 12Vdc 65mA @ 24Vdc	295mA @ 12Vdc 280mA @ 24Vdc	780mA @ 24Vdc	

Power and Signal Connections:

Connect to the device using two DB9 connectors.

The female top connection is PROFIBUS.

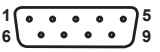
The male connection on the side is power and RS-232 or RS-485.

Pin out diagrams for all PROFIBUS enabled Alicat devices are shown:

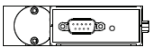
TOP

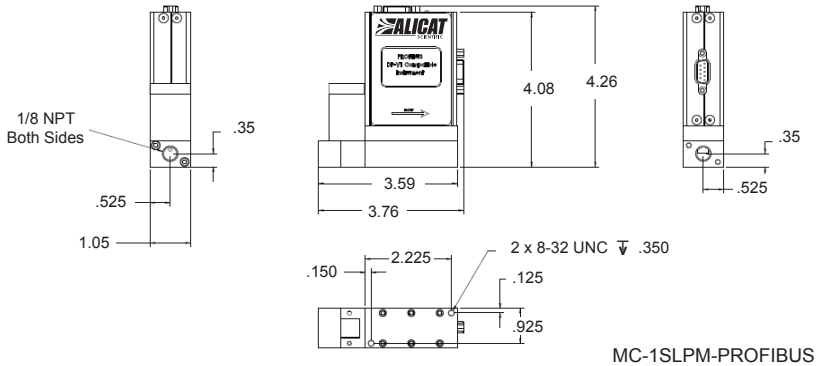
1. NC
2. OPT GND
3. DP
4. RTS
5. DGD
6. VP
7. OPT 7 to 30VDC
8. DN
9. NC

SIDE



1. NC
2. RS232RX
3. RS232TX
4. NC
5. GND
6. NC
7. 7 to 30VDC
8. GND
9. NC





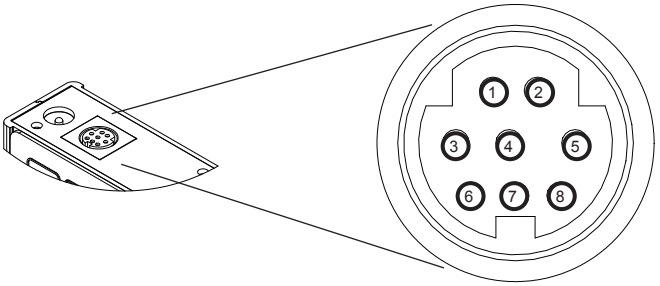
MC-1SLPM-PROFIBUS

PROFIBUS MC1SLPM shown to provide PROFIBUS connector dimensions only. Flow body and valve dimensions will vary with range. Please see Alicat's device specifications for complete dimensions.

PROFIBUS units do not have a display screen.

Eight Pin Mini-DIN Connector Pin-Outs

If your Alicat Instrument was ordered with the standard Eight Pin Mini-DIN connection, please be sure to reference the following pin-out diagram.

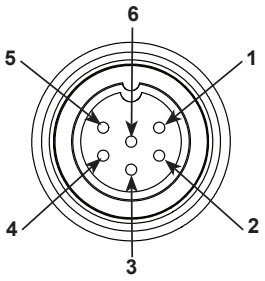


Standard 8 Pin Mini-DIN Pin-Out

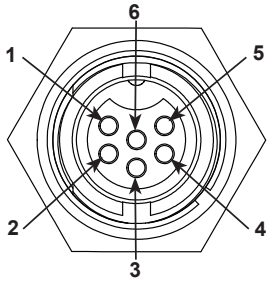
Pin	Function	Mini-DIN cable color
1	Inactive (or optional 4-20mA Primary Output Signal)	Black
2	Static 5.12 Vdc [or optional Secondary Analog Output (4-20mA, 5Vdc, 10Vdc) or Basic Alarm]	Brown
3	Serial RS-232RX / RS-485(–) Input Signal (receive)	Red
4	Analog Input Signal	Orange
5	Serial RS-232TX / RS-485(+) Output Signal (send)	Yellow
6	0-5 Vdc (or optional 0-10 Vdc) Output Signal	Green
7	Power In (as described above)	Blue
8	Ground (common for power, digital communications, analog signals and alarms)	Purple
Note: The above pin-out is applicable to all the flow meters and controllers with the Mini-DIN connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.		

Locking Industrial Connector Pin-Outs

If your Alicat Instrument was ordered with a Six Pin Locking Industrial connection, please be sure to reference the following pin-out diagram.



Male Connector: Cable



Female Connector: Device

Pin	Function
1	Power In (+)
2	RS-232TX / RS-485(+)
3	RS-232RX / RS-485(-)
4	Remote Tare Meters (Ground to Tare) Analog Set-Point Input (Controllers)
5	Ground (common for power, communications and signals)
6	Signal Out (Voltage or Current as ordered)

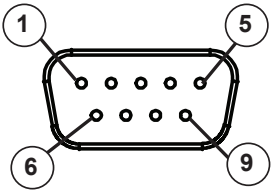
The above pin-out is applicable to all the flow meters and controllers ordered with the industrial connector. The availability of different output signals depends on the flow meter options ordered.

The locking industrial connector is standard on all CSA/ATEX approved devices. RS-485 is not available on CSA/ATEX approved devices.

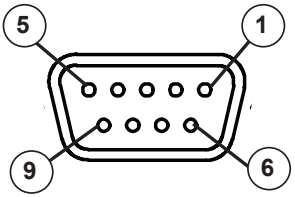
If your instrument was ordered with a DB9 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

Standard DB9 Pin-out

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB9 wire to a **DB9** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB9 offerings, along with some options for customization.



Male Connector Front View



Female Connector Front View

Pin	Function
1	Not Connected (4-20mA analog output signal optional)
2	5.12 Vdc or (secondary analog output (4-20mA, 5Vdc, 10Vdc or alarm optional)
3	Serial RS-232RX or RS-485(-)
4	Analog Input Signal [4-20mA, 5Vdc, or 10Vdc] (short to ground for remote tare function on non-controllers)
5	Serial RS-232TX or RS-485(+)
6	0-5 Vdc Output Signal (or 0-10 Vdc optional)
7	Power In (+Vdc)
8	Ground (common for power, digital communications, analog signals and alarms)
9	Ground (common for power, digital communications, analog signals and alarms)
Note: The above pin-out is applicable to all the flow meters and controllers with the **DB9** connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.	

STOP

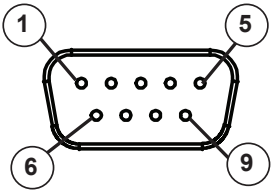
Do not connect RS-485 to RS-232 units or cables. Damage will occur! Check part number or contact factory to verify RS-485 functionality.

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

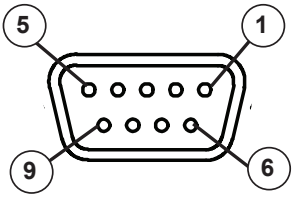
If your instrument was ordered with a DB9 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

DB9A Pin-out

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB9 wire to a **DB9A** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB9N offerings, along with some options for customization.



Male Connector Front View



Female Connector Front View

Pin	Function
1	Not Connected
2	0-5 Vdc Output Signal (or 0-10 Vdc optional)
3	Power In (+Vdc)
4	Ground (common for power, digital communications, analog signals and alarms)
5	Serial RS-232TX or RS-485 (+)
6	Analog Input Signal [4-20mA, 5Vdc, or 10Vdc] (short to ground for remote tare function on non-controllers)
7	Ground (common for power, digital communications, analog signals and alarms)
8	Ground (common for power, digital communications, analog signals and alarms)
9	Serial RS-232RX or RS-485 (-)
Note: The above pin-out is applicable to all the flow meters and controllers with the **DB9A** connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.	

STOP

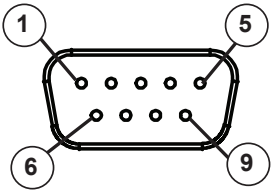
Do not connect RS-485 to RS-232 units or cables. Damage will occur! Check part number or contact factory to verify RS-485 functionality.

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

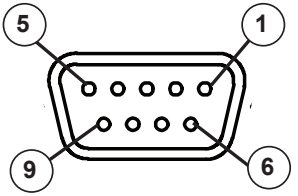
If your instrument was ordered with a DB9 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

DB9N Pin-out

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB9 wire to a **DB9N** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB9N offerings, along with some options for customization.



Male Connector Front View



Female Connector Front View

Pin	Function
1	Power In (+Vdc)
2	Analog Input Signal [4-20mA, 5Vdc, or 10Vdc] (short to ground for remote tare function on non-controllers)
3	0-5 Vdc Output Signal (or 0-10 Vdc optional)
4	Not Connected
5	Ground (common for power, digital communications, analog signals and alarms)
6	Ground (common for power, digital communications, analog signals and alarms)
7	Serial RS-232RX or RS-485 (-)
8	Serial RS-232TX or RS-485 (+)
9	Not Connected
Note: The above pin-out is applicable to all the flow meters and controllers with the **DB9N** connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.	

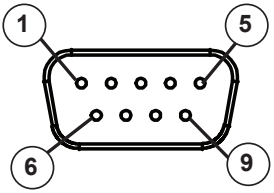
STOP **Do not connect RS-485 to RS-232 units or cables. Damage will occur! Check part number or contact factory to verify RS-485 functionality.**

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

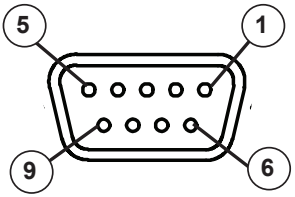
If your instrument was ordered with a DB9 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

DB9T Pin-out

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB9 wire to a **DB9T** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB9T offerings, along with some options for customization.



Male Connector Front View



Female Connector Front View

Pin	Function
1	Serial RS-232TX or RS-485 (+)
2	0-5 Vdc Output Signal (or 0-10 Vdc optional)
3	Power In (+Vdc)
4	Ground (common for power, digital communications, analog signals and alarms)
5	Not Connected
6	Analog Input Signal [4-20mA, 5Vdc, or 10Vdc] (short to ground for remote tare function on non-controllers)
7	Ground (common for power, digital communications, analog signals and alarms)
8	Ground (common for power, digital communications, analog signals and alarms)
9	Serial RS-232RX or RS-485 (-)
Note: The above pin-out is applicable to all the flow meters and controllers with the **DB9T** connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.	

STOP

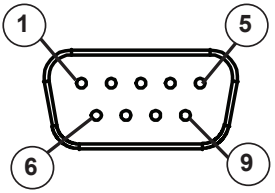
Do not connect RS-485 to RS-232 units or cables. Damage will occur! Check part number or contact factory to verify RS-485 functionality.

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

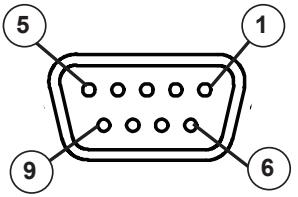
If your instrument was ordered with a DB9 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

DB9U Pin-out

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB9 wire to a **DB9U** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB9U offerings, along with some options for customization.



Male Connector Front View

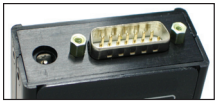


Female Connector Front View

Pin	Function
1	Serial RS-232RX or RS-485(-)
2	0-5 Vdc Output Signal (or 0-10 Vdc optional)
3	Power In (+Vdc)
4	Ground (common for power, digital communications, analog signals and alarms)
5	Not Connected
6	Analog Input Signal [4-20mA, 5Vdc, or 10Vdc] (short to ground for remote tare function on non-controllers)
7	Ground (common for power, digital communications, analog signals and alarms)
8	Ground (common for power, digital communications, analog signals and alarms)
9	Serial RS-232TX or RS-485(+)
Note: The above pin-out is applicable to all the flow meters and controllers with the **DB9U** connector. The availability of different output signals depends on the options ordered. Optional configurations are noted on the unit's calibration sheet.	

STOP **Do not connect RS-485 to RS-232 units or cables. Damage will occur! Check part number or contact factory to verify RS-485 functionality.**

Due to variance in cable manufacturing, please identify proper wiring/pins via continuity check & color when using blunt cut multi-strand cables.

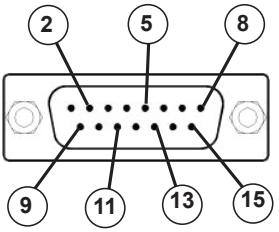


DB15 Pin-Outs

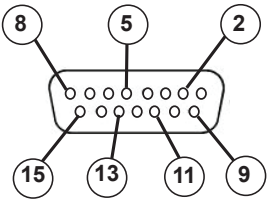
If your instrument was ordered with a DB15 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB15 wire to a **DB15** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB15 offerings, along with some options for customization.

DB15 – Pin-Out Alicat Style



Male Connector Front View



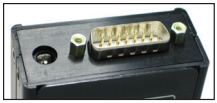
Female Connector Front View

Pin Number	Function
1	Ground
2	Primary Analog Signal Output
3	Ground
4	N/C
5	Power Supply (+Vdc)
6	N/C
7	N/C
8	Analog Tare (meters — when grounded) Analog Set-Point Input (controllers)
9	Power Supply Common
10	Ground
11	Secondary Analog Signal Output / fixed 5.12Vdc
12	N/C
13	RS-232 RX (receive) or RS-485 –
14	Ground
15	RS-232 TX (send) or RS-485 +

Check your device's calibration certificate and user manual for the actual electrical input/output requirements, as all instruments are custom configured to some extent.

NOTE: Pins 1, 3, 9, 10 and 14 are connected together inside of the device and are common grounding points.

N/C = Not Connected/Open (can be used for custom pin assignments – please consult factory).

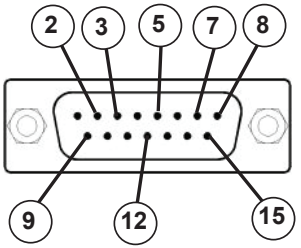


DB15 Pin-Outs

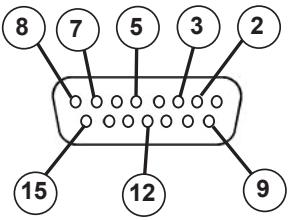
If your instrument was ordered with a DB15 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB15 wire to a **DB15A** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB15 offerings, along with some options for customization.

DB15A – Pin-Out "Aalborg" Style



Male Connector Front View



Female Connector Front View

Pin Number	Function
1	Ground
2	Primary Analog Signal Output
3	Analog Tare (meters — when grounded)* Analog Set-Point Input (controllers)*
4	Ground
5	Power Supply Common
6	Ground
7	Power Supply (+Vdc)
8	RS-232 Tx (send) / RS-485, A (-) [receive]
9	Ground
10	N/C
11	N/C
12	Secondary Analog Signal Output / fixed 5.12Vdc*
13	N/C
14	N/C
15	RS-232 Rx (receive) / RS-485, A (+) [send]

Check your device's calibration certificate and user manual for the actual electrical input/output requirements, as all instruments are custom configured to some extent.

* Added to allow for full use of features on Alicat devices, may not be present on host wiring

NOTE: Pins 1, 4, 5, 6 and 9 are connected together inside of the device and are common grounding points.

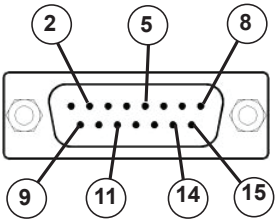
N/C = Not Connected/Open (can be used for custom pin assignments – please consult factory).

DB15 Pin-Outs

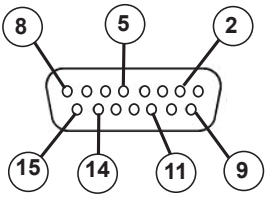
If your instrument was ordered with a DB15 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB15 wire to a **DB15B** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB15 offerings, along with some options for customization.

DB15B – Pin-Out "Brooks" Style



Male Connector Front View



Female Connector Front View

Pin Number	Function
1	Ground
2	Primary Analog Signal Output
3	N/C
4	N/C
5	Power Supply (+Vdc)
6	N/C
7	N/C
8	Analog Tare (meters — when grounded) Analog Set-Point Input (controllers)
9	Power Supply Common
10	Ground
11	Secondary Analog Signal Output / fixed 5.12Vdc
12	N/C
13	N/C
14	RS-232 RX (receive) or RS-485 –
15	RS-232 TX (send) or RS-485 +

Check your device's calibration certificate and user manual for the actual electrical input/output requirements, as all instruments are custom configured to some extent.

NOTE: Pins 1, 9,and 10 are connected together inside of the device and are common grounding points.

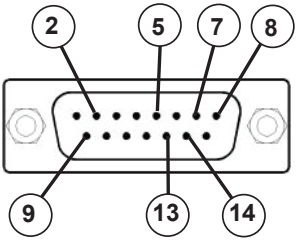
N/C = Not Connected/Open (can be used for custom pin assignments – please consult factory).

DB15 Pin-Outs

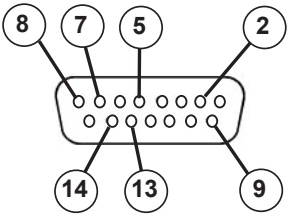
If your instrument was ordered with a DB15 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB15 wire to a **DB15K** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB15 offerings, along with some options for customization.

DB15K – Pin-Out "MKS" Style



Male Connector Front View



Female Connector Front View

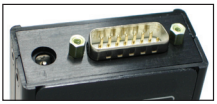
Pin Number	Function
1	N/C
2	Primary Analog Signal Output
3	N/C
4	N/C
5	Power Supply Common
6	N/C
7	Power Supply (+Vdc)
8	Analog Tare (meters — when grounded) Analog Set-Point Input (controllers)
9	Secondary Analog Signal Output / fixed 5.12Vdc *
10	N/C
11	Ground
12	Ground
13	RS-232 RX (receive) or RS-485 – *
14	RS-232 TX (send) or RS-485 + *
15	Ground

Check your device's calibration certificate and user manual for the actual electrical input/output requirements, as all instruments are custom configured to some extent.

NOTE: Pins 5, 11, 12 and 15 are connected together inside of the device and are common grounding points.

N/C = Not Connected/Open (can be used for custom pin assignments – please consult factory).

***** Added to allow for full use of features on Alicat devices, may not be present on host wiring.

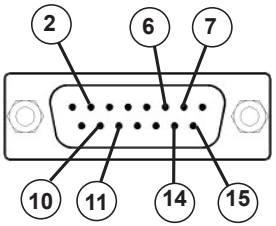


DB15 Pin-Outs

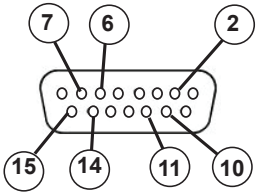
If your instrument was ordered with a DB15 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB15 wire to a **DB15H** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB15 offerings, along with some options for customization.

DB15H – Pin-Out "Hastings H" Style



Male Connector Front View



Female Connector Front View

Pin Number	Function
1	N/C
2	RS-232 RX (receive) or RS-485 – *
3	N/C
4	N/C
5	Ground
6	Primary Analog Signal Output
7	Power Supply Common
8	N/C
9	N/C
10	Secondary Analog Signal Output / fixed 5.12Vdc *
11	Power Supply (+Vdc)
12	Ground
13	N/C
14	Analog Tare (meters — when grounded) Analog Set-Point Input (controllers)
15	RS-232 TX (send) or RS-485 + *

Check your device's calibration certificate and user manual for the actual electrical input/output requirements, as all instruments are custom configured to some extent.

NOTE: Pins 5, 7 and 12 are connected together inside of the device and are common grounding points.

N/C = Not Connected/Open (can be used for custom pin assignments – please consult factory).

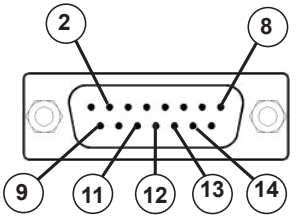
***** Added to allow for full use of features on Alicat devices, may not be present on host wiring.

DB15 Pin-Outs

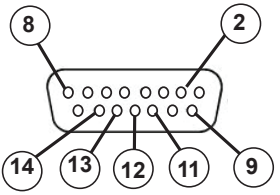
If your instrument was ordered with a DB15 connection, be sure to check the Calibration Label on the device and reference the appropriate pin-out diagram.

The following pin-out chart describes the safest and generally compatible arrangement when connecting a non-Alicat DB15 wire to a **DB15S** equipped Alicat. Not all features may be available between brands, but the common denominators are featured in our DB15 offerings, along with some options for customization.

DB15S – Pin-Out "Sierra" Style



Male Connector Front View



Female Connector Front View

Pin Number	Function
1	Ground
2	Primary Analog Signal Output
3	N/C
4	N/C
5	Ground
6	N/C
7	N/C
8	Analog Tare (meters — when grounded) Analog Set-Point Input (controllers)
9	Power Supply Common
10	Ground
11	Secondary Analog Signal Output / fixed 5.12Vdc *
12	RS-232 RX (receive) or RS-485 – *
13	Power Supply (+Vdc)
14	RS-232 TX (send) or RS-485 + *
15	Ground

Check your device's calibration certificate and user manual for the actual electrical input/output requirements, as all instruments are custom configured to some extent.

NOTE: Pins 1, 5, 9, 10 and 15 are connected together inside of the device and are common grounding points.

N/C = Not Connected/Open (can be used for custom pin assignments – please consult factory).

***** Added to allow for full use of features on Alicat devices, may not be present on host wiring.

Additional Information for Alicat CSA and ATEX Approved Devices

See the following page for Special Conditions regarding the use of these units!

II 3 G

EEx nA IIC T4

Class I, Div. 2 Group A, B, C and D T4

24 Vdc, 0.800A max

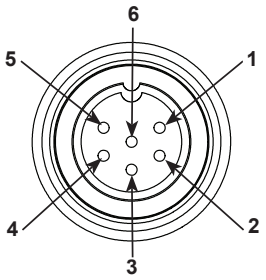
Class I, Zone 2 AEx nA IIC T4

WARNINGS:

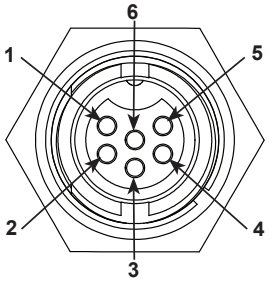
EXPLOSION HAZARD – DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.

EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

All Alicat CSA / ATEX approved devices are equipped with a locking 6 pin industrial connector. The power and signal connections are shown below.

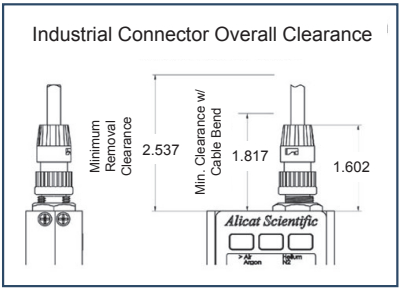


Male Connector: Cable



Female Connector: Device

Pin	Function
1	Power In (+)
2	RS-232TX
3	RS-232RX
4	Remote Tare Meters (Ground to Tare) Analog Set-Point Input (Controllers)
5	Ground (common for power, communications and signals)
6	Signal Out (Voltage or Current as ordered)



Clearance Requirements for Industrial Connector

USE of Alicat instruments (M, MW, MS, MC, MCW, MCS, MCR, MCRW, MCRS, P, PS, PC, PCS, PCR and PCRS product families only) in Class 1 Division 2 applications.

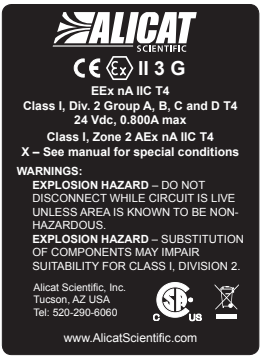
CSA certifies the use of this product for general use as well as use in hazardous locations as defined by Class 1 Division 2 Group A, B, C and D T4.

CSA certification is indicated by the product label as shown below and not by the statements in this, or any accompanying documentation.

Special Conditions:

To comply with CSA certification the following information is included in the product literature:

- When equipment is properly labeled, it is suitable in Class I, Division 2, Group A, B, C and D, T4
  - Tamb. -40°C to +50°C
- Electrical Rating 24Vdc, 0.800A max
- Instruments shall be powered by a CSA certified, UL listed, Class II external power supply suitable for the application
- Instruments shall be housed in an enclosure with a minimum IP54 rating or location providing equivalent protection
- Instrument's final approval shall be provided by the local authority having jurisdiction


ALICAT
SCIENTIFIC
II 3 G
EEx nA IIC T4
Class I, Div. 2 Group A, B, C and D T4
24 Vdc, 0.800A max
Class I, Zone 2 AEx nA IIC T4
X – See manual for special conditions
WARNINGS:
EXPLOSION HAZARD – DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.
EXPLOSION HAZARD – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.
Alicat Scientific, Inc.
Tucson, AZ USA
Tel: 520-290-6060
C US
www.AlicatScientific.com

USE of Alicat instruments (M, MS, MC, MCS, MCR, MCRS, P, PS, PC, PCS, PCR and PCRS product families only) in applications requiring ATEX Certification.

Properly labeled Alicat instruments comply to the following ATEX standard:

II 3 G EEx nA IIC T4 (-40°C ≤ Ta ≤ +50°C)

The examination certificate was issued by the CSA in accordance with accepted practices and procedures. This confirms compliance with the European ATEX Directive or Group II Category 3G equipment.

ATEX certification is indicated by the product label as shown above and not by the statements in this, or any accompanying documentation.

Special Conditions:

- Properly labeled equipment is only certified for use in ambient temperatures in the range of -40°C to +50°C only
- Electrical Rating 24Vdc, 0.800A max
- Instruments shall be powered by a CSA certified, UL listed, Class II external power supply suitable for the application
- Instruments shall be housed in an enclosure with a minimum IP54 rating or location providing equivalent protection
- Instrument's final approval shall be provided by the local authority having jurisdiction

Serial Number: _____

Model Number: _____

Notice: Alicat Scientific, Inc. reserves the right to make any changes and improvements to the products described in this manual at any time and without notice. This manual is copyrighted. This document may not, in whole or in part, be copied, reproduced, translated, or converted to any electronic medium or machine readable form, for commercial purposes, without prior written consent from the copyright holder.

Note: Although we provide assistance on Alicat Scientific products both personally and through our literature, it is the complete responsibility of the user to determine the suitability of any product to their application.

Limited Lifetime Warranty

Alicat Scientific, Inc. warrants to the original purchaser (hereinafter referred to as "Buyer") that instruments manufactured by Alicat Scientific (hereinafter referred to as "Product") shall be free from defects in materials and workmanship for the life of the Products.

Under this warranty, the Products will be repaired or replaced at manufacturer's option, without charge for parts or labor when the Product is carried or shipped prepaid to the factory together with proof of purchase. The foregoing shall constitute the exclusive and sole remedy in lieu of other remedies of the Buyer for any breach by Alicat Scientific of this warranty to the maximum extent permitted by law.

This warranty does not apply to any Product which has not been installed or used in accordance with the Product operation and installation specifications provided to Buyer verbally or in writing by Alicat Scientific for the proper and normal use of the Product.

Buyer agrees hereunder that Alicat reserves the right to void any warranty, written or implied, if upon Alicat's examination of Product shall disclose to Alicat's satisfaction that the Product failure was due solely, or in part, to accident, misuse, neglect, abuse, alteration, improper installation, unauthorized repair or improper testing by Buyer or agent of Buyer.

Alicat Scientific shall not be liable under any circumstances for indirect, special, consequential, or incidental damages in connection with, or arising out of, the sale, performance, or use of the Products covered by this warranty.

Alicat Scientific does not recommend, warrant or assume responsibility for the use of the Products in life support applications or systems.

Alicat's warranties as herein above set forth shall not be enlarged, diminished or affected by, and no obligation or liability shall arise or grow out of Alicat's rendering of technical advice in connection with Buyer's order of the Products furnished hereunder.

If Product becomes obsolete, Alicat Scientific, at its own discretion, reserves the right to repair the Product with available replacement parts or upgrade the Product to a current, commercially available version of the original Product. Should upgrading the Product be deemed necessary by Alicat, Buyer hereby agrees to pay an upgrade fee equal to seventy percent of the retail value of the replacement Product. Alicat Scientific hereunder makes no claim that replacement Products will look, function or operate in the same or similar manner as the original product.

When a Product is returned to Alicat Scientific for recalibration this service is considered normal preventative maintenance. Recalibration of Product shall not be treated as a warranty service unless recalibration of Product is required as the result of repairs to Product pursuant to this Warranty. Failure of Buyer to send Product to Alicat Scientific for recalibration on a yearly basis after a period of 36 months from date of manufacture will remove any and all obligations regarding repair or replacement of Product as outlined by this Warranty to Buyer from Alicat Scientific.

This Warranty is in lieu of all other relevant warranties, expressed or implied, including the implied warranty of merchantability and the implied warranty of fitness for a particular purpose, and any warranty against infringement of any patent.

Continued use or possession of Products after expiration of the applicable warranty period stated above shall be conclusive evidence that the warranty is fulfilled to the full satisfaction of Buyer.

Alicat makes no warranty as to experimental, non-standard or developmental Products.

Accessories purchased from Alicat are not covered by this warranty.

Conformity / Supplemental Information:

The product complies with the requirements of the Low Voltage Directive 2006/95/EC and the EMC Directive 2004/108/EC and carries the CE Marking accordingly. Contact the manufacturer for more information.

Gas Viscosity, Density and Compressibility:

#	Gas		Absolute Viscosity* 25°C	Density ** 25°C 14.696PSIA	Compressibility 25°C 14.696PSIA
0	Air	Air	184.918	1.1840	0.9997
1	Argon	Ar	225.593	1.6339	0.9994
2	Methane	CH4	111.852	0.6569	0.9982
3	Carbon Monoxide	CO	176.473	1.1453	0.9997
4	Carbon Dioxide	CO2	149.332	1.8080	0.9949
5	Ethane	C2H6	93.540	1.2385	0.9924
6	Hydrogen	H2	89.153	0.08235	1.0006
7	Helium	He	198.457	0.16353	1.0005
8	Nitrogen	N2	178.120	1.1453	0.9998
9	Nitrous Oxide	N2O	148.456	1.8088	0.9946
10	Neon	Ne	311.149	0.8246	1.0005
11	Oxygen	O2	204.591	1.3088	0.9994
12	Propane	C3H8	81.458	1.8316	0.9841
13	normal-Butane	n-C4H10	74.052	2.4494	0.9699
14	Acetylene	C2H2	104.448	1.0720	0.9928
15	Ethylene	C2H4	103.177	1.1533	0.9943
16	iso-Butane	i-C4H10	74.988	2.4403	0.9728
17	Krypton	Kr	251.342	3.4274	0.9994
18	Xenon	Xe	229.785	5.3954	0.9947
19	Sulfur Hexafluoride	SF6	153.532	6.0380	0.9887

#	Gas		Absolute Viscosity* 25°C	Density ** 25°C 14.696PSIA	Compressibility 25°C 14.696PSIA
20	75%Ar / 25% CO2	C-25	205.615	1.6766	0.9987
21	90% Ar / 10% CO2	C-10	217.529	1.6509	0.9991
22	92% Ar / 8% CO2	C-8	219.134	1.6475	0.9992
23	98% Ar / 2% CO2	C-2	223.973	1.6373	0.9993
24	75% CO2 / 25% Ar	C-75	167.451	1.7634	0.9966
25	75% Ar / 25% He	A-75	230.998	1.2660	0.9997
26	75% He / 25% Ar	A-25	234.306	0.5306	1.0002
27	90% He / 7.5% Ar / 2.5% CO2 Helistar® A1025	A1025	214.840	0.3146	1.0003
28	90% Ar / 8% CO2 / 2% O2 Stargon® CS	Star29	218.817	1.6410	0.9992
29	95% Ar / 5% CH4	P-5	223.483	1.5850	0.9993

*in micropoise (1 Poise = gram / (cm) (sec)) **Grams/Liter
Reference: NIST REFPROP 7 Database

Flow Conversions:

SCFM	1.00 = 28.3160	SLPM	SLPM	100.00 = 3.5316		SCFM
SCFH	1.00 = 0.4719	SLPM	SLPM	100.00 = 211.9093		SCFH
SCIM	100.00 = 1.6390	SLPM	SLPM	1.00 = 61.0128		SCIM
SCIH	1000.00 = 0.2732	SLPM	SLPM	1.00 = 3660.7688		SCIH

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